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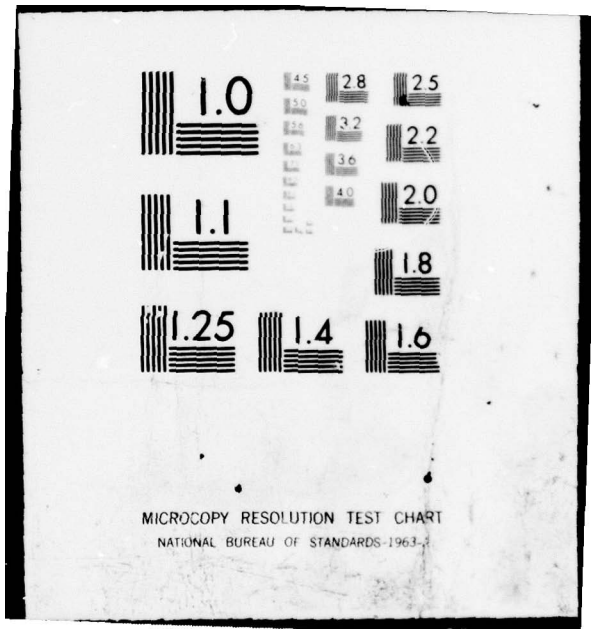
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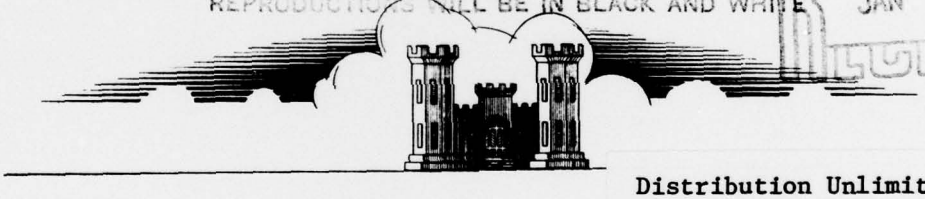
OHIO RIVER BASIN
VIRGIN RUN, FAYETTE COUNTY

PENNSYLVANIA

VIRGIN RUN DAM

NDS I.D. No. PA - 00196
PENNDER I.D. No. 26 - 85

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

AUGUST 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topograhic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Virgin Run Dam: NDI I.D. No. PA-00196

Owner:	Pennsylvania Fish Commission
State Located:	Pennsylvania (PennDER I.D. No. 26-85)
County Located:	Fayette
Stream:	Virgin Run
Inspection Date:	5 July 1979
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

Based on a visual inspection, operational history, and available engineering data, the dam is considered to be in fair condition.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility is the Probable Maximum Flood (PMF). Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store about 62 percent of the PMF prior to embankment overtopping. Consequently, the spillway is assessed as being inadequate, but not seriously inadequate.

Deficiencies noted by the inspection team included heavy overgrowth across the downstream toe, a questionable structural and foundation design associated with the spillway, and an inadequate emergency warning system.

It is recommended that the owner immediately:

a. Clear the downstream embankment slope and toe area (to a distance at least 100 feet beyond the embankment toe) of all trees and overgrowth that hinder visual evaluation of the facility.

b. Restore foundation support to the lower end of the right spillway endwall just beyond the plunge pool.

c. Reevaluate the present spillway design and investigate the condition beneath the channel floor to determine the extent of erosion which has contributed to a loss of foundation support. Subsequent remedial work should be performed as deemed necessary.

d. Reevaluate and revise the present flood emergency procedures for Virgin Run Dam in accordance with, but not imited to, the following items:

1. The inclusion of a definite procedure to notify downstream residents of a possible emergency.

2. Provisions for an alternate means of communications in the event telephone lines become inoperative.

3. Provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

(6) National Dam Inspection Program. Virgin Run Dam (NDS I.D. Number PA-00196, PennDer I.D. Number 26-85), Ohio River Basin, Virgin Run, Fayette County, Pennsylvania. Phase I Inspection Report,

(10) Bernard M. Mihalcin

(11) Aug 79

(12) 85

(15) DACW31-79-C-0013

411 002

JCB

GAI Consultants, Inc.

Bernard M. Mihalcin, P.E.

Date 28 August 1979

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date 18 Sep 79

OVERVIEW PHOTOGRAPH

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
VIRGIN RUN DAM
NDI# PA-196, PENNDER# 26-85

SECTION 1
GENERAL INFORMATION

1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Virgin Run Dam is a zoned earth embankment approximately 34 feet high and 400 feet long (not including spillway). The facility is provided with a trapezoidal-shaped, concrete chute channel spillway, with discharges controlled by a concrete weir structure, located at the left abutment. The spillway overflow weir measures 78 feet in length. The outlet works consists of a 3-foot square reinforced concrete culvert that discharges at the downstream embankment toe. Flow through the culvert is regulated via stop logs set within a concrete vertical riser positioned along the upstream embankment face.

b. Location. Virgin Run Dam is located on Virgin Run in Franklin and Perry Townships, Fayette County, Pennsylvania, about two miles east of Perryopolis, Pennsylvania. The dam, reservoir, and watershed are contained within the Dawson, Pennsylvania, U.S.G.S. 7.5 minute topographic quadrangle. The coordinates of the dam are N40° 02' and W79° 43' (see Appendix G).

c. Size Classification. Small (34 feet high; 690 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

e. Ownership. Pennsylvania Fish Commission
P. O. Box 1673
Harrisburg, Pennsylvania 17120

f. Purpose. Public fishing.

g. Historical Data. Virgin Run Dam was designed for the Pennsylvania Fish Commission by the Chester Engineers of Pittsburgh, Pennsylvania. One of the principal designers, Mr. Charles A. Tanner, eventually formed the contracting firm which subsequently constructed the facility in 1953. Periodic progress reports were issued by the Commission and the construction site was visited frequently by PennDER personnel. No indications of major problems are contained within the available PennDER correspondence and the project was completed as scheduled.

1.3 Pertinent Data.

a. Drainage Area (square miles). 3.3

b. Discharge at Dam Site.

Discharge Capacity of the Outlet Conduit - Discharge curves are not available.

Discharge Capacity of the Spillway at Maximum Pool ≈ 4610 cfs.

c. Elevations (feet above mean sea level). The following elevations were obtained from design drawings and through field measurements based on the elevation of the spillway crest at 1,175 feet.

Top of Dam	1182.0 (design) 1181.6 (field)
Maximum Design Pool	Not known
Maximum Pool of Record	Not known
Normal Pool	1175
Upstream Inlet Invert	1150.7
Downstream Outlet Invert	1148.4 (design) 1147.7 (field)
Streambed at Dam Centerline	1149
Maximum Tailwater	Not known

d. Reservoir Length (feet).

Top of Dam	3800
Normal Pool	2200

e. Storage (acre-feet).

Top of Dam	690
Normal Pool	420
Design Surcharge	Not known

f. Reservoir Surface (acres).

Top of Dam	49
Normal Pool	32
Maximum Design Pool	Not known

g. Dam.

Type	Zoned earth.
Length	400 feet (not including spillway).
Height	34 feet (field measured; crest to downstream toe).
Top Width	10 feet (field) 8 feet (design)
Upstream Slope	3H:1V
Downstream Slope	2.5H:1V
Zoning	Two zones (see Figure 4). Class "A" fill is defined as selected impervious material free from vegetable matter and stones greater than 6 inches in maximum dimension. Class "B" fill is defined as pervious material that may contain stones, but, no vegetable matter.
Impervious Core	See "Zoning" above.
Cutoff	8-foot wide trench excavated 3 feet into clayey materia along dam centerline.

e. Storage (acre-feet).

Top of Dam	690
Normal Pool	420
Design Surcharge	Not known

f. Reservoir Surface (acres).

Top of Dam	49
Normal Pool	32
Maximum Design Pool	Not known

g. Dam.

Type	Zoned earth.
Length	400 feet (not including spillway).
Height	34 feet (field measured; crest to downstream toe).
Top Width	10 feet (field) 8 feet (design)
Upstream Slope	3H:1V
Downstream Slope	2.5H:1V
Zoning	Two zones (see Figure 4). Class "A" fill is defined as selected impervious material free from vegetable matter and stones greater than 6 inches in maximum dimension. Class "B" fill is defined as pervious material that may contain stones, but, no vegetable matter.
Impervious Core	See "Zoning" above.
Cutoff	8-foot wide trench excavated 3 feet into clayey material along dam centerline.

	Grout Curtain	None indicated.
h.	Diversion Canal and Regulating Tunnels.	None.
i.	Spillway.	
	Type	Trapezoidal-shaped concrete chute channel, with discharges controlled by a concrete weir structure, located at the left abutment.
	Crest Elevation	1175 feet.
	Crest Length	78 feet.
j.	Outlet Works.	
	Type	3-foot square reinforced concrete culvert.
	Length	160 feet (inlet to outlet).
	Closure and Regulating Facilities	Flow through outlet is controlled via removable stop logs set in grooves within a reinforced concrete riser situated along the upstream embankment face.
	Access	Control tower riser accessible from embankment crest.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No design reports or calculations are available for any aspect of the facility. Design drawings are available from both the Pennsylvania Fish Commission and PennDER. Narratives detailing the design features are also contained in PennDER files. Contract specifications and information regarding minor design changes are available from Pennsylvania Fish Commission files.

b. Design Features.

1. Embankment. The contract drawings indicate that the embankment is a zoned earth structure 32 feet high and 490 feet in length.

The embankment is comprised of two zones as shown on Figure 4. The larger zone is composed of material designated as class "A" fill and extends from the upstream toe to the downstream edge of the embankment crest. The remainder of the structure is composed of material designated as class "B" fill. Construction specifications define class "A" fill as "selected impervious and structurally sound material, free from vegetable matter and stones greater than 6 inches in maximum dimension." Class "B" fill is defined as "structurally sound material, sufficiently pervious to drain the embankment, and may contain stones but no vegetable matter." No information is available pertaining to the engineering properties of the fill; however, it was reportedly placed in 6-inch layers and compacted with a sheepsfoot roller.

A cutoff trench was reportedly excavated along the centerline of the dam to a depth of 3 feet into clayey material. The bottom width of the trench is 8 feet.

The dam is 10 feet wide at the crest and has slopes of roughly 3H:1V upstream and 2.5H:1V downstream. Field measurements indicate that additional material was placed along the crest, increasing the top width from the design 8 feet and locally steepening the upper portions of both the upstream and downstream embankment slopes. The upstream face is protected from wave action by a layer of hand-placed concrete block riprap, 8 inches thick, resting on a 6-inch layer of gravel or crushed stone. The riprap layer extends 2.5 feet below and 3 feet above normal pool (see Figure 3 and Photograph 4).

2. Appurtenant Structures.

a) Spillway. The spillway at Virgin Run Dam is a trapezoidal-shaped, concrete chute channel, with discharges controlled by a reinforced concrete overflow weir structure, located at the left abutment (see Photograph 2). The spillway channel is partially unlined as it was cut into durable rock (see Figure 5 and Photograph 3). The original design was altered somewhat during construction to include the addition of a concrete apron as shown on Figure 6.

b) Outlet Works. The outlet works consist of a reinforced concrete riser (see Figure 4 and Photograph 4) and 3-foot square horizontal box culvert which discharges at the downstream embankment toe (see Photograph 6). Flow through the outlet is controlled via removable stop logs set in grooves within the riser (see Photograph 5).

c. Specific Design Data and Criteria.

1. Hydrology and Hydraulics. Although no formal design reports or calculations are contained in PennDER or Pennsylvania Fish Commission files, the capacity of the spillway is referenced in much of the available correspondence. The spillway was designed prior to the development of the Pennsylvania "C" Curve, which for a drainage area of 3.4 square miles, would have required the spillway capacity to equal approximately 1100 csm (cubic feet per second per square mile). The Chester Engineers originally designed the spillway with a capacity of about 2700 csm. At that time, the owner considered this to be excessive, and subsequently, persuaded state officials and the designer to accept a lower final design capacity equivalent to approximately 1500 csm.

2. Embankment. No design data are available.

3. Appurtenant Structures. No design data are available.

2.2 Construction Records.

Contract drawings, specifications, construction progress reports, and construction photographs are available from PennDER and Pennsylvania Fish Commission files. No field testing records are available.

2.3 Operational Records.

No records of the day-to-day operation of this facility are maintained.

2.4 Other Investigations.

No formal investigations have been performed on this facility subsequent to its construction.

2.5 Evaluation.

Engineering data in the form of drawings, specifications, miscellaneous calculations, correspondence, and photographs are available from PennDER and Pennsylvania Fish Commission files. The data are considered adequate to make a reasonable Phase I assessment of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests the dam and its appurtenances are currently in fair condition.

b. Embankment. Observations made during the visual inspection indicate the embankment is in good condition. No evidence of seepage through the embankment was observed nor were there any signs of sloughing, erosion, excess settlement or animal burrows. Heavy overgrowth, including trees and high brush, covers the entire downstream embankment toe and extends a minimum of about 12 feet up the slope (see Photographs 6 and 7). The remainder of the embankment is well maintained. The hand-placed block riprap, protecting the upstream slope, is in excellent condition while the grass covered portions of the embankment have been recently mowed.

c. Appurtenant Structures.

1. Spillway. The visual inspection revealed the spillway to be in fair condition. Minor cracking was observed along various portions of the spillway channel floor and sidewalls. For the most part, the larger cracks were sealed and filled with bitumen. The inspection team probed the area beneath the concrete spillway floor slab with a standard 6-foot rule and found extensive voids, some in excess of the rule length (see Figure 1). Some undercutting of the right spillway endwall, just beyond the plunge pool, has also occurred.

2. Outlet Works. The outlet works at Virgin Run Dam is in excellent condition. No signs of deterioration were observed on any of the visible exposed concrete surfaces, including a large portion of the interior of the control tower riser (see Photographs 4 and 5). The stop logs were in place although exhibiting some leakage. The 3-foot square discharge culvert could not be entered, however, due to tailwater and discharge through the stop logs (see Photograph 6).

d. Reservoir Area. The area surrounding the reservoir is characterized by gentle to moderate slopes that are generally heavily forested along the southern and eastern shores of the lake (see Photograph 1), but only partially wooded to the west (see Photograph 4). Virgin Run Lake is a

recreational facility and parts of its shoreline have been equipped with parking, fishing, and boating facilities.

e. Downstream Channel. The channel downstream of Virgin Run Dam is contained within a narrow, partially wooded and partially agricultural valley with steep confining slopes. Several residences are located in the 2-mile long valley that leads to the Youghiogheny River; however, only one dwelling is considered sufficiently near the stream to possibly be affected by the floodwave resulting from an embankment breach. The dwelling is situated on the left downstream bank at a distance approximately 1,300 feet from the embankment and about 15 feet above the streambed (see Photograph 8). Therefore, the hazard classification is considered to be high.

3.2 Evaluation.

The overall appearance of the facility indicates it to be in fair condition. Heavy overgrowth across the downstream embankment toe should be removed and repairs should be performed on the spillway where required.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

Virgin Run Dam is essentially a self-regulating facility. Excess inflows are automatically discharged through the spillway located at the right abutment whose overflow weir crest is set at elevation 1175.0. The outlet conduit is generally used only for the purpose of drawing down the reservoir with flows being manually controllled via stop logs set in grooves within the control tower riser. The top stop log is normally set at elevation 1175.5. Thus, under high flows, the outlet conduit will also begin to discharge once the reservoir has risen 0.5-foot above the crest of the spillway.

The Pennsylvania Fish Commission has recently developed a formal "Operation and Maintenance Manual" for Virgin Run Dam that outlines both routine and emergency operating procedures.

4.2 Maintenance of Dam.

Maintenance of Virgin Run Dam is performed in accordance with the procedures and guidelines set forth in the "Operation and Maintenance Manual" developed by the Pennsylvania Fish Commission. Included in the manual is a maintenance checklist covering the entire facility.

4.3 Maintenance of Operating Facilities

See Section 4.2 above.

4.4 Warning System.

The "Operation and Maintenance Manual" contains procedures for operation of the facility during a flood emergency.

Review of the procedures indicates possible deficiencies in the plan which include the lack of:

a. Definite procedures to notify downstream residents of an impending emergency situation.

b. Provisions for an alternative means of communication in the event telephone lines are inoperative.

c. Provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

4.5 Evaluation.

Adequate operation and maintenance procedures for Virgin Run Dam have been established by the Pennsylvania Fish Commission and set forth in a formal manual. The manual also contains procedures for operation of the facility during a flood emergency; however, consideration should be given to modifying the emergency plan in accordance with, but not limited to, the items listed in Section 4.4, herein.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No formal design reports or calculations are contained in PennDER or Pennsylvania Fish Commission files. Available correspondence indicates that the spillway was designed prior to the development of the Pennsylvania "C" Curve, which for a drainage area of 3.4 square miles, would have required the spillway capacity to equal approximately 1100 cubic feet per second per square mile (csm). The Chester Engineers originally designed the spillway with a capacity of about 2700 csm. At that time, the owner considered this to be excessive, and subsequently, persuaded state officials and the designer to accept a lower final design capacity equivalent to approximately 1500 csm.

5.2 Experience Data.

Daily records of reservoir levels and/or spillway discharge are not available.

5.3 Visual Observations.

Observations made during the visual inspection indicate that the structural integrity of the spillway channel is questionable. Extensive voids were discovered beneath the individual concrete slabs of the channel floor which are located in the portion of the spillway that is not founded on durable rock (see Figure 5). It can be speculated that, under high flows, sufficient pressures could develop on top and beneath the slabs to break and/or dislodge them, leading to a possibly dangerous condition. In addition, the right spillway endwall beyond the plunge pool has been undercut, apparently by water discharging over the end sill of the spillway plunge pool, and has lost some foundation support. This condition, if left unchecked, could lead to cracking and deterioration of the lower spillway.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army, Corps of Engineers, Hydrologic

Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix C.

5.5 Summary of Analysis

a. Spillway Design Flood (SDF). In accordance with the procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Virgin Run Dam ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. This classification is based on the relative size of the dam (small), and the potential hazard of dam failure to downstream developments (high). Due to the large volume of stored water that could be released should the embankment fail (≈690 acre-feet), the SDF for this facility is considered to be the PMF.

b. Results of Analysis. Virgin Run Dam was evaluated under near normal operating conditions. That is, the reservoir was initially at its normal pool or spillway elevation of 1175.0 feet, with the spillway weir discharging freely. However, the usually discharging outlet conduit was assumed to be non-functional for the purpose of analysis. In any event, the flow capacity of the outlet conduit is not such that it would significantly increase the total discharge capabilities of the facility. The spillway is a trapezoidal-shaped, concrete chute channel with discharges controlled by a concrete weir structure. All pertinent engineering calculations relative to the evaluation of this facility are provided in Appendix C.

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Virgin Run Dam can accommodate only about 62 percent of the PMF (SDF) prior to overtopping of the embankment (Appendix C, Summary Input/Output Sheets, Sheet C). The peak PMF inflow of approximately 7900 cfs was somewhat attenuated by the discharge/storage capabilities of the dam and reservoir such that the resulting peak PMF outflow was about 7640 cfs (Summary Input/Output Sheets, Sheets B and C). Under the PMF, the embankment would be overtopped for approximately 3.8 hours, with a maximum depth of inundation equal to about 1.6 feet above the low top of dam elevation of 1181.6 feet (Summary Input/Output Sheets, Sheet C).

5.6 Spillway Adequacy.

Although Virgin Run Dam cannot accommodate its SDF (the PMF), the possible downstream consequences of embankment

failure due to overtopping were not evaluated. Breaching analysis of the dam was not performed, since the facility can safely pass a flood of at least 1/2 PMF magnitude. Since Virgin Run Dam cannot accommodate a PMF-size flood, its spillway is considered to be inadequate, but not seriously inadequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment appears to be in good condition. No evidence of seepage through the face of the embankment was detected nor were any signs of sloughing, erosion, excess settlements, or animal borrows observed. The heavy overgrowth along the downstream toe hinders expedient inspection of a most vital area of the structure. More importantly, such extensive overgrowth, if neglected for a long period, will deeply root itself into the embankment and present a potential structural hazard.

b. Appurtenant Structures.

1. Spillway. Observations made during the visual inspection indicate that the structural integrity of the spillway channel is questionable. Extensive voids were discovered beneath the individual concrete slabs of the channel floor which are located in the portion of the spillway that is not founded on durable rock. It can be speculated that, under high flows, sufficient pressures could develop on top and beneath the slabs to break and/or dislodge them, leading to a possibly dangerous condition. In addition, the right spillway endwall beyond the plunge pool has been undercut, apparently by water discharging over the end sill of the spillway plunge pool, and has lost some foundation support. This condition, if left unchecked, could lead to cracking and deterioration of the lower spillway.

2. Outlet Works. The outlet works, including the 3-foot square discharge culvert and control tower riser, appear to be well designed. All visible portions were found in excellent condition.

6.2 Design and Construction Techniques.

No formal design reports or calculations are available. Some design data is available in the form of design drawings, construction specifications, and correspondence contained in both PennDER and Pennsylvania Fish Commission files. Based on the limited information available, the facility appears to be adequately designed and constructed with the possible exception of the spillway channel floor (see 6.1.b above).

6.3 Past Performance.

According to Pennsylvania Fish Commission personnel, the facility has operated virtually problem-free throughout its 26-year history.

6.4 Seismic Stability.

The dam is located within Seismic Zone No. 1. It is thought that the static stability of the structure is sufficient to withstand possible minor earthquake induced dynamic forces. However, no calculations and/or investigations were performed to confirm this belief.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection, operational history, and available engineering data suggest that the facility is in fair condition.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility is the Probable Maximum Flood (PMF). Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store about 62 percent of the PMF prior to embankment overtopping. Consequently, the spillway is assessed as being inadequate, but not seriously inadequate.

Deficiencies noted by the inspection team included heavy overgrowth across the downstream embankment toe, a questionable structural and foundation design associated with the spillway floor slab, and an inadequate emergency warning system.

b. Adequacy of Information. The available data are considered sufficient to make an accurate assessment of the facility.

c. Urgency. It is suggested that the recommendations listed below be implemented as soon as possible.

d. Necessity for Additional Investigations. Additional investigations are considered necessary and are listed in Section 7.2 below.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner immediately:

a. Clear the downstream embankment slope and toe area (to a distance at least 100 feet beyond the embankment toe) of all trees and overgrowth that hinder visual evaluation of the facility.

b. Restore foundation support to the lower end of the right spillway endwall just beyond the plunge pool.

c. Reevaluate the present design and investigate the condition beneath the spillway channel floor to determine the extent of erosion which has contributed to a loss of foundation support and perform remedial work as deemed necessary.

d. Reevaluate and revise the present flood emergency procedures for Virgin Run Dam in accordance with, but not limited to, the following items:

1. The inclusion of a definite procedure to notify downstream residents of a possible emergency.

2. Provisions for an alternate means of communications in the event telephone lines become inoperative.

3. Provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

APPENDIX A

CHECK LIST - ENGINEERING DATA

NAME OF DAM: Virgin Run Dam

NDI#: PA-196 PENNDER# : 26-85

CHECK LIST
ENGINEERING DATA
PHASE I

ITEM	REMARKS NDI# PA - 196
PERSONS INTERVIEWED AND TITLE	PA Fish Commission (PFC) E. Jon Grindall - Engineer Clyde Buell - District Two Facilities Manager Dan O'Neill - Maintenance Superintendent
REGIONAL VICINITY MAP	See Appendix G (U.S.G.S. 7.5 minute topographic quadrangle, Dawson, Pennsylvania).
CONSTRUCTION HISTORY	From PennDER files: Charles W. Tanner (Pittsburgh, PA) Contractor (previously engineer with Chester) Chester Engineers - Designer Good series of photos in PFC files just after construction and during reservoir fill-up.
AVAILABLE DRAWINGS	Design drawings available from PennDER. As-built data on sketches from Pennsylvania Fish Commission.
TYPICAL DAM SECTIONS	See Figures 3 and 4, Appendix F.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Figure 3, Appendix F. See Figure 4, Appendix F. None available.

ITEM	REMARKS NDI# PA - 196
SPILLWAY: PLAN SECTION DETAILS	See Figure 5, Appendix F. Modifications shown on Figure 6, Appendix F, (available from PFC files).
OPERATING EQUIPMENT PLANS AND DETAILS	See Figure 4, Appendix F.
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None from owner. Geology briefly discussed in PennDER review report.
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	None available. Considerable H&H discussions in PennDER correspondence. Rainfall and stream records in PFC files for the years 1938 through 1948. Stability or seepage analyses are not available.
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	One deep well log in PennDER and PFC files.

ITEM	REMARKS NDI# PA - 196
BORROW SOURCES	Spillway excavation and possibly within reservoir area.
POST CONSTRUCTION DAM SURVEYS	None by PFC.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	One PennDER inspection report since construction contained in PennDER files.
HIGH POOL RECORDS	Not known.
MONITORING SYSTEMS	None.
MODIFICATIONS	None since construction. Spillway apron added during construction (see Figure 6, Appendix F).

ITEM	REMARKS	NDI# PA 196
PRIOR ACCIDENTS OR FAILURES	None.	
MAINTENANCE: RECORDS MANUAL	Maintenance records by C. Buell available at Somerset office of PFC. Formal "Operations and Maintenance Manual" by PFC staff is complete and has been recently instituted as part of this facility (copy received by inspection team).	
OPERATION: RECORDS MANUAL	See above.	
OPERATIONAL PROCEDURES	Procedure detailed in new manual. Basically self-regulating.	
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	Emergency Plan detailed in new manual.	
MISCELLANEOUS		

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-196
PENN DER ID # 26-85

SIZE OF DRAINAGE AREA: 3.3 square miles

ELEVATION TOP NORMAL POOL: 1175 STORAGE CAPACITY: 420 acre-feet

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -

ELEVATION TOP DAM: 1181.6 STORAGE CAPACITY: 690 acre-feet

SPILLWAY DATA

CREST ELEVATION: 1175.0

TYPE: Trapezoidal-shaped chute channel with concrete overflow wei

CREST LENGTH: 78 feet

CHANNEL LENGTH: 145 feet

SPILLOVER LOCATION: Left abutment

NUMBER AND TYPE OF GATES: None

OUTLET WORKS

TYPE: 3-foot square concrete conduit with control tower riser

LOCATION: Near centerline of embankment

ENTRANCE INVERTS: 1150.7 feet

EXIT INVERTS: 1147.7 feet

EMERGENCY DRAWDOWN FACILITIES: Stop logs set in control tower riser

HYDROMETEOROLOGICAL GAGES

TYPE: None

LOCATION: -

RECORDS: -

MAXIMUM NON-DAMAGING DISCHARGE: Not known

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Virgin Run Dam STATE Pennsylvania COUNTY Fayette

NDI# PA - 196 PENNDER# 26-85

TYPE OF DAM Zoned Earth SIZE Small HAZARD CATAGORY High

DATE(S) INSPECTION 5 July 1979 WEATHER Partly Cloudy TEMPERATURE 60° @ 1:00 p.m.

POOL ELEVATION AT TIME OF INSPECTION 1175 M.S.L.

TAILWATER AT TIME OF INSPECTION 1149.7 M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	OTHERS
B. M. Mihalcin	PA Fish Commission	
W. J. Veon	E. Jon Grindall	
D. L. Bonk	Dan O'Neill	
	Clyde Buell	

RECORDED BY D. L. Bonk

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 196
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical - good. Horizontal - good; minor settlement measured on the order of 0.4-foot maximum.
RIPRAP FAILURES	Riprap spotty along spillway channel wall. Additional riprap required. Embankment riprap consists of hand-placed concrete block riprap.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 196
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	No damp areas were observed. Heavy overgrowth, including trees and high brush, covers the entire downstream embankment toe and extends a mininum of about 12 feet up the slope.
ANY NOTICEABLE SEEPAGE	None observed through embankment or near toe.
STAFF GAGE AND RECORDER	None.
DRAINS	None observed.

OUTLET WORKS

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 196
INTAKE STRUCTURE	Submerged, not observed.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	Good condition. No evidence of concrete deterioration on exposed surfaces including a large portion of the interior of the control tower riser. Conduit was discharging during the inspection and was not entered for observation.
OUTLET STRUCTURE	Concrete headwall in good condition. Headwall is surrounded by trees and brush that characterize the general area at the downstream toe of the embankment.
OUTLET CHANNEL	Unlined trapezoidal-shaped channel.
GATE(S) AND OPERATIONAL EQUIPMENT	Flow through outlet is controlled via stop logs set in grooves within the control tower riser.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 196
TYPE AND CONDITION	Uncontrolled trapezoidal-shaped chute channel with a reinforced concrete overflow weir structure in fair condition. Minor cracking observed along concrete surfaces. Some cracks have been filled and sealed.
APPROACH CHANNEL	Rock lined channel floor with significant algae growth. Riprap spotty along left sidewall of channel.
SPILLWAY CHANNEL AND SIDEWALLS	Minor undercutting observed between the channel floor and right vertical sidewall. Extensive voids, measured in excess of 6 feet, extend beneath the channel floor.
STILLING BASIN PLUNGE POOL	Rock lined plunge pool in excellent condition.
DISCHARGE CHANNEL	Unlined trapezoidal-shaped channel.
BRIDGE AND PIERS	None.
EMERGENCY GATES	None.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 196
TYPE AND CONDITION	N/A
APPROACH CHANNEL	N/A
OUTLET STRUCTURE	N/A
DISCHARGE CHANNEL	N/A

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 196
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA -196
SLOPES: RESERVOIR	The area surrounding the reservoir is characterized by gentle to moderate slopes that are generally heavily forested along the southern and eastern shores of the lake, but only partially wooded to the west.
SEDIMENTATION	No evidence of sedimentation observed. Heavy algae growth observed in spillway approach channel.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Narrow, partially wooded and partially agricultural valley with steep confining slopes.
SLOPES: CHANNEL VALLEY	See above.
APPROXIMATE NUMBER OF HOMES AND POPULATION	Several residences are located in the 2-mile long valley that leads to the Youghiogheny River; however, only one dwelling is considered sufficiently near the stream to possibly be affected by the floodwave resulting from an embankment breach. The dwelling is situated on the left downstream bank at a distance approximately 1,300 feet from the embankment and about 15 feet above the streambed.

APPENDIX C

HYDROLOGY AND HYDRAULICS

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam; and (2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as outlined below.

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specific breach criteria and normal reservoir outflow.

d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak, and maximum water surface elevation(s) of the failure hydrograph(s) for each location.

SUBJECT DAM SAFETY INSPECTION
VIRGIN RUN DAM

BY WJV DATE 7-19-79 PROJ. NO. 78-617-196

CHKD. BY DLB DATE 7-24-79 SHEET NO. 1 OF 14

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DAM STATISTICS

- HEIGHT OF DAM ≈ 34 FT (FIELD MEASURED)
  (MEASURED FROM OUTLET INVERT)

- MAXIMUM POOL STORAGE CAPACITY ≈ 690 AC-FT (FROM HEC-1)
  @ TOP OF DAM

- NORMAL POOL STORAGE CAPACITY ≈ 420 AC-FT (SEE NOTE 1)

- DRAINAGE AREA ≈ 3.3 SQMI

PLANIMETERED OFF USGS 7.5 MINUTE QUADS: DAWSON AND FAYETTE CITY, PA

NOTE 1: NORMAL POOL STORAGE CAPACITY OBTAINED FROM "DAMS, RESERVOIRS, AND NATURAL LAKES", WATER RESOURCES BULLETIN NO. 5, COMMONWEALTH OF PENNSYLVANIA, DEPARTMENT OF FORESTS AND WATERS, HARRISBURG, PENNSYLVANIA, 1970. THE ACTUAL REPORTED VALUE WAS 137 MILLION GALLONS.

DAM CLASSIFICATION

DAM SIZE - SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF - ½ PMF TO PMF (REF 1, TABLE 3)

SUBJECT DAM SAFETY INSPECTION
VIRGIN RUN DAM

BY WJV DATE 7-21-79 PROJ. NO. 79-617-196

CHKD. BY DLB DATE 7-24-79 SHEET NO. 2 OF 14

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HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE ≈ 2.4 MI

L_{CA} ≈ 0.9 MI (MEASURED ALONG THE LONGEST WATERCOURSE FROM THE DAM CREST TO THE BASIN CENTROID)

NOTE 2: VALUES OF L AND L_{CA} ARE MEASURED FROM THE USGS 7.5 MINUTE DAWSON AND FAYETTE CITY, PA QUADS. ALL HYDROGRAPH VARIABLES ARE DEFINED IN REF. 2, IN THE SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH".

C_t ≈ 1.0
C_p ≈ 0.45

[SUPPLIED BY COE; ZONE 25 OHIO RIVER BASIN]

t_p = SNYDER'S STANDARD LAG ≈ $1.0 (L \times L_{CA})^{0.3}$

$\therefore t_p \approx 1.0 (2.4 \times 0.9)^{0.3} \approx 1.26$ HR

RESERVOIR SURFACE AREAS

SURFACE AREA (SA) @ NORMAL POOL EL 1175.0 ≈ 32 AC

SA @ EL 1180.0 ≈ 45 AC

SA @ EL 1185.0 ≈ 58 AC

SA @ EL 1190.0 ≈ 70 AC

[SURFACE AREA VALUES OBTAINED BY PLANIMETERING APPROPRIATE CONTOUR AREAS AS GIVEN ON FIG 2. NORMAL POOL EL 1175.0 OBTAINED FROM FIG 5.]

LOW TOP OF DAM @ EL 1191.6 FT

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RATE OF RESERVOIR SURFACE AREA INCREASE PER FOOT OF RESERVOIR RISE BETWEEN EL 1190.0 AND EL 1195.0
$\Rightarrow$

$$\Delta SA/\Delta H \approx (58 - 45)\,AC / (1195.0 - 1190.0)\,FT$$
$$\approx 2.6\ AC/FT$$

SA @ LOW TOP OF DAM EL 1181.6 FT $\approx 45\,AC + \left[(2.6\ \frac{AC}{FT})(1181.6 - 1190.0\right]$
$\approx 49\,AC$

RESERVOIR ELEVATION @ "0" STORAGE

NORMAL POOL VOLUME $\approx \frac{1}{3}$ HA ≈ 420 AC-FT (CONIC METHOD)

SA @ NORMAL POOL EL 1175.0 ≈ 32 AC

$\therefore H \approx (420\,AC\text{-}FT)(3)/(32\,AC) \approx 39.4$ FT

ZERO VOLUME ELEVATION $\approx 1175.0 - 39.4$ FT ≈ 1135.6 FT

NOTE 3: ALTHOUGH THE ACTUAL MINIMUM RESERVOIR ELEVATION IS PROBABLY HIGHER THAN THE ABOVE COMPUTED VALUE, IN ORDER TO CALCULATE AN ELEVATION - STORAGE RELATIONSHIP AND STILL MAINTAIN A STORAGE OF 420 AC-FT @ NORMAL POOL EL 1175.0 THE ABOVE "0" STORAGE ELEVATION MUST BE INPUT INTO THE HEC-1 PROGRAM.

RESERVOIR ELEVATION - STORAGE RELATIONSHIP

COMPUTED INTERNALLY BY THE HEC-1 PROGRAM, BASED ON THE GIVEN ELEVATION VS SURFACE AREA INFORMATION AS PREVIOUSLY PRESENTED (SEE SUMMARY INPUT / OUTPUT SHEETS).

SUBJECT DAM SAFETY INSPECTION
VIRGIN RUN DAM

BY WJV DATE 7-22-79 PROJ. NO. 78-617-196

CHKD. BY DLB DATE 7-24-79 SHEET NO. 4 OF 14

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PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 24 IN (REF 3, FIG 1)
  (CORRESPONDING TO A DURATION OF 24 HR AND AN AREA OF 200 SQ. MI IN SOUTHWESTERN PENNSYLVANIA)

- DEPTH - AREA - DURATION ZONE #7 (REF 3, Fig 1)

- DRAINAGE AREA ≈ 3.3 SQ MI ⇒ ASSUME THAT DATA CORRESPONDING TO A 10 SQ. MI. AREA IS REPRESENTATIVE OF THIS BASIN:

DURATION (HR)	PERCENT OF INDEX RAINFALL (%)
6	102
12	120
24	130
48	140

- HOPBROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALLER BASIN) CORRESPONDING TO A DA ≈ 3.3 SQ MI (< 10 SQ MI) ⇒ 0.90 (REF 4, PG 49)

SUBJECT DAM SAFETY INSPECTION
VIRGIN RUN DAM

BY WJV DATE 7-22-79 PROJ. NO. 79-617-196

CHKD. BY DLB DATE 7-24-79 SHEET NO. 5 OF 14

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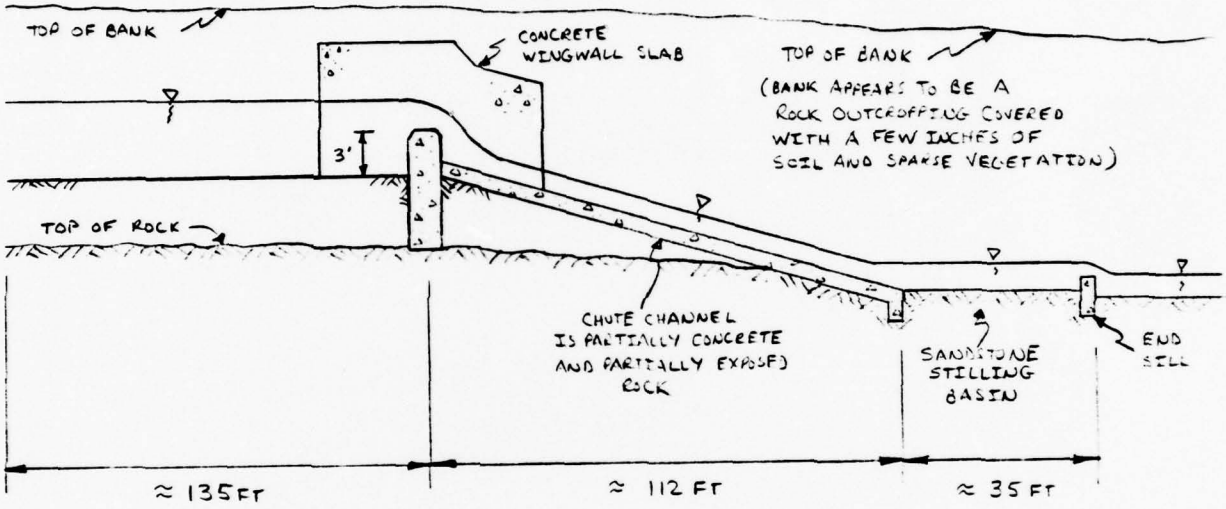
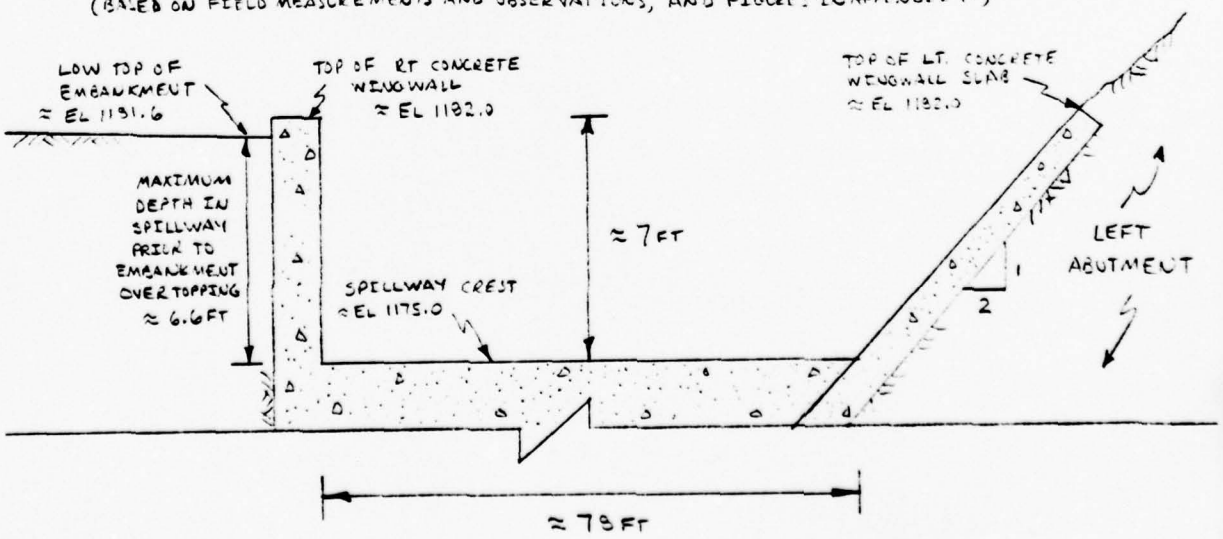
SPILLWAY CAPACITY

- PROFILE OF SPILLWAY : (NOT TO SCALE)
(BASED ON FIELD MEASUREMENTS AND OBSERVATIONS, AND FIGURES IN APPENDIX F)



- CROSS-SECTION OF SPILLWAY : (NOT TO SCALE)
(BASED ON FIELD MEASUREMENTS AND OBSERVATIONS, AND FIGURES IN APPENDIX F)



SECTION TAKEN LOOKING UPSTREAM TOWARD SPILLWAY

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- THE SPILLWAY IS A CONCRETE CHUTE CHANNEL WITH DISCHARGE CONTROLLED BY A CONCRETE WEIR STRUCTURE. THE WEIR HAS VERTICAL US AND DS SIDESLOPES, AND A CREST BREADTH OF ABOUT 2 FT. EVEN THOUGH THE CREST IS NOT SHARP-EDGED, IT WILL BE ASSUMED THAT THE DESIGN DISCHARGE COEFFICIENT IS ON THE ORDER OF 3.33. THIS COEFFICIENT VALUE CORRESPONDS TO THAT EXPECTED IF THE CREST WAS ACTUALLY "SHARP-CRESTED" (REF 5, PG 5-7), AND ALSO TO THAT EXPECTED FOR A 2 FT BROAD-CRESTED WEIR W/ HEADS IN EXCESS OF ABOUT 4 FT (REF 5, PG 5-40).

- DISCHARGE OVER THE WEIR CAN BE DEFINED BY THE EQUATION:

$$Q_w = CLH^{3/2} \qquad \text{(REF 4, PG 373)}$$

WHERE Q_w = DISCHARGE OVER THE WEIR IN CFS;
L = LENGTH OF WEIR CREST $\approx$ 78 FT;
H = HEIGHT OF RESERVOIR ABOVE SPILLWAY CREST, ASSUMED DESIGN HEAD $\approx$ 6.6 FT;
C = DISCHARGE COEFFICIENT = 3.33 @ DESIGN HEAD.

- DISCHARGE ALONG THE INCLINED WINGWALL WILL BE ASSUMED TO OCCUR AT THE SAME VELOCITY AS THE DISCHARGE OVER THE WEIR. THEREFORE WINGWALL FLOW CAN BE DEFINED BY THE CONTINUITY EQUATION:

$$Q_{ww} = \bar{V}_w A_{ww} = \left(Q_w / A_w\right) A_{ww} \qquad \text{(REF 1, PG 3-4)}$$

WHERE Q_{ww} = DISCHARGE OVER THE INCLINED WINGWALL IN CFS;

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v_w = VELOCITY OF WEIR DISCHARGE IN FPS;
A_{ww} = FLOW AREA ABOVE INCLINED WINGWALL IN FT^2; AND
A_w = FLOW AREA ABOVE WEIR IN FT^2.

- APPROACH CHANNEL LOSSES @ DESIGN FLOW:

a) APPROXIMATE APPROACH CHANNEL WIDTH = 100 FT (FIG 3)
RIGHT SIDE OF APPROACH CHANNEL (RT WINGNALL) ⇒ VERTICAL SS
LEFT SIDE OF APPROACH CHANNEL (INCL. LT WINGWALL) ⇒ 2H TO 1V SS

∴ @ RESERVOIR EL 1191.6 (LOW TOP OF DAM) THE MAXIMUM APPROACH CHANNEL DEPTH = FOREBAY DEPTH + HEAD OVER WEIR CREST ≈ 3.0 FT + 6.6 FT ≈ 9.6 FT

⇒ AVERAGE APPROACH CHANNEL FLOW AREA ≈ A_a

$$A_a \approx (9.6\text{ FT} \times 100\text{ FT}) + [\tfrac{1}{2}(9.6\text{ FT} \times 2)(9.6\text{ FT})]$$
$$A_a \approx 1052\text{ FT}^2$$

b) INITIAL ESTIMATE OF DISCHARGE @ EL 1191.6 FT

$$Q_w = CLH^{3/2} \approx (3.33)(75\text{ FT})(6.6)^{3/2} \approx 4400\text{ CFS}$$

$$A_w \approx 6.6\text{ FT} \times 75\text{ FT} \approx 515\text{ FT}$$

$$\therefore Q_{ww} \approx \left(\frac{4400\text{ CFS}}{515\text{ FT}}\right) \times [\tfrac{1}{2}(2 \times 6.6\text{ FT})(6.6\text{ FT})]$$
$$\approx 370\text{ CFS}$$

$$\Rightarrow Q_{TOTAL} \approx 4400\text{ CFS} + 370\text{ CFS} \approx 4770\text{ CFS}$$

c) AVERAGE APPROACH CHANNEL VELOCITY ≈ Q_{TOTAL}/A_a

$$v_a \approx \frac{4770\text{ CFS}}{1052\text{ FT}^2} \approx 4.5\text{ FPS}$$

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⇒ AVERAGE APPROACH VELOCITY HEAD = $h_a \approx \bar{v}_a^2/2g$

$h_a \approx (4.5 \text{ FPS})^2/2g \approx 0.31$ FT

ASSUMING THAT THE APPROACH CHANNEL ENTRANCE LOSS $\approx 0.1\, h_a$ (REF 4, PG 379) ⇒ 0.03 FT

D) APPROACH CHANNEL FRICTION LOSS = $h_f \approx \left[\bar{v}_a\, n/1.49\, R_h^{2/3}\right]^2 \times L_c$

WHERE L_c = AVERAGE APPROACH CHANNEL LENGTH ≈ 135 FT (SEE FIG 3);

n = MANNING'S ROUGHNESS COEFFICIENT ≈ 0.04 (REF 7, PG 112; EXCAVATED CHANNEL, COBBLE BOTTOM AND CLEAN SIDES);

R_h = HYDRAULIC RADIUS = FLOW AREA/WETTED PERIMETER. FLOW AREA ≈ A_a ≈ 1052 FT², LEFT WALL OF APPROACH CHANNEL IS ON A 2H TO 1V SS AND VARIES TO 0 FT HEIGHT @ THE ENTRANCE (FIG 3), RIGHT WALL (RT WW) OF APPROACH CHANNEL AVERAGES ABOUT 6 FT IN EFFECTIVE HEIGHT (FIG 5), WETTED PERIMETER ≈ 100 FT + 6 FT + 11 FT ≈ 117 FT ⇒ $R_h \approx 1052\text{FT}^2/117\text{FT}$ ⇒ $R_h \approx 9.0$ FT

∴ $h_f \approx (135\text{ FT})\left[(4.5)(0.04)/1.49\,(9.0)^{2/3}\right]^2 \approx 0.11$ FT

∴ TOTAL APPROACH CHANNEL LOSS ≈ 0.11 FT + 0.03 FT ≈ 0.14 FT

⇒ ACTUAL EFFECTIVE HEAD ≈ 6.6 FT − 0.14 FT ≈ 6.46 FT

– SPILLWAY CAPACITY @ LOW TOP OF DAM EL 1191.6 :

SUBJECT DAM SAFETY INSPECTION
VIRGIN RUN DAM

BY WJV DATE 7-22-79 PROJ. NO. 79-617-196

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$$Q_w \approx (3.33)(78\,FT)(6.46\,FT)^{3/2} \approx 4260\ CFS$$

$$A_w \approx 6.46\,FT \times 78\,FT \approx 504\,FT^2$$

$$Q_{ww} \approx \left(4260\ CFS / 504\,FT^2\right) \times \left[\tfrac{1}{2}(6.46\,FT \times 2)(6.46\,FT)\right]$$
$$\approx 350\ CFS$$

$$\therefore Q_{TOTAL} \approx 4260 + 350 \approx 4610\ CFS$$

SPILLWAY RATING CURVE

AS THE HEAD ABOVE THE WEIR BECOMES SMALL, THE ROUGHNESS OF THE CREST AND THE CONTACT PRESSURE BETWEEN THE WATER AND THE CREST EXERT A LARGER INFLUENCE ON DISCHARGES. THAT IS, THE C-VALUES DECREASE WITH DECREASING HEAD. THE OPPOSITE TREND OCCURS FOR HIGHER HEADS. THEREFORE, ASSUME THAT THE DISCHARGE COEFFICIENT - HEAD RELATIONSHIP FOR AN OGEE-CRESTED WEIR (REF 4, PG 378, FIG 250) CAN REPRESENT THE ACTUAL DISCHARGE COEFFICIENT - HEAD RELATIONSHIP FOR THE PRESENT CONCRETE WEIR STRUCTURE. THE MAXIMUM HEAD PRIOR TO OVERTOPPING OF THE EMBANKMENT, 6.6 FT, WILL BE ASSUMED TO BE THE DESIGN HEAD (H_o). THE DESIGN DISCHARGE COEFFICIENT (C_o) WILL BE ASSUMED TO EQUAL 3.33.

ALL DISCHARGES OVER THE WEIR ARE DEFINED BY THE $Q_w = CLH^{3/2}$ RELATIONSHIP AND ALL DISCHARGES OVER THE INCLINED WINGWALL ARE DEFINED BY THE $Q_{ww} = (Q_w/A_w)\,A_{ww}$ RELATIONSHIP AS GIVEN ON SHEET 6. THE HEAD OVER THE WEIR WILL BE ADJUSTED TO ACCOUNT FOR APPROACH CHANNEL LOSSES.

SUBJECT DAM SAFETY INSPECTION

VIRGINIA LAKE DAM

BY WJV DATE 7-23-79 PROJ. NO. 73-617-196

CHKD. BY DLB DATE 7-24-79 SHEET NO. 10 OF 14

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- SPILLWAY RATING TABLE : (TABLE CONTINUED ON SHEET 11)

RESERVOIR ELEVATION (FT)	H (FT)	H/H_o (FT/FT)	(1) C/C_o	(2) C	INITIAL ESTIMATES (3) Q_w (CFS)	(4) A_w (FT^2)	(5) A_{ww} (FT^2)	(6) Q_{ww} (CFS)	(7) Q_{TOT} (CFS)	(8) A_a (FT^2)
1175	0	–	–	–	0	–	–	0	0	–
1176	1	0.15	0.84	2.80	220	78	1	0	220	416
1177	2	0.30	0.88	2.93	650	156	4	20	670	525
1178	3	0.45	0.91	3.03	1230	234	9	50	1280	636
1179	4	0.61	0.94	3.13	1950	312	16	100	2050	749
1180	5	0.76	0.97	3.23	2820	390	25	180	3000	864
1181	6	0.91	0.99	3.30	3780	468	36	290	4070	981
1181.6	6.6	1.0	1.0	3.33	4400	515	43.6	370	4770	1052
1183	8	1.21	1.025	3.41	6020	624	64	620	6640	1221
1184	9	1.36	1.04	3.46	7290	702	81	840	8130	1344
1185	10	1.52	1.06	3.53	8710	780	100	1120	9830	1469
1186	11	1.67	1.07	3.56	10130	858	121	1430	11560	1596

(1) C/C_o OBTAINED FROM REF 4, PG 378, FIG. 250; BASED ON H/H_o VALUE

(2) $C = C/C_o \times 3.33$

(3) $Q_w = C\,(78FT)\,H^{3/2}$

(4) $A_w = (78FT) \times H$

(5) $A_{ww} = \frac{1}{2}\,(2 \times H)(H) = H^2$

(6) $Q_{ww} = (Q_w/78H)\,(H^2)$

(7) $Q_{TOT} = Q_w + Q_{ww}$

(8) $A_a = [100FT \times (3FT + H)] + \{\frac{1}{2}[2(3FT + H)](3FT + H)\} = [100FT \times (3FT + H)] + (3FT + H)^2$

SUBJECT DAM SAFETY INSPECTION
VIRGIN RUN DAM

BY WJV DATE 7-23-79 PROJ. NO. 79-617-196
CHKD. BY DLB DATE 7-24-79 SHEET NO. 11 OF 14

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- SPILLWAY RATING TABLE : (CONTINUED FROM SHEET 10)

(9) v_a (FPS)	(10) h_a (FT)	(11) ENTRANCE LOSS $0.1 h_a$ (FT)	(12) FRICTION LOSS h_f (FT)	(13) EFFECTIVE H_e (FT)	FINAL VALUES (14) Q_w (CFS)	A_w (FT²)	A_{ww} (FT²)	Q_{ww} (CFS)	Q_{TOT} (CFS)	RESERVOIR ELEVATION (FT)
–	–	–	–	–	0	-	-	0	0	1175
0.5	0.00	0.00	0.00	1.0	220	78	1	0	220	1176
1.3	0.03	0.00	0.02	1.98	640	154	4	20	660	1177
2.0	0.06	0.01	0.04	2.95	1200	230	9	50	1250	1178
2.7	0.11	0.01	0.06	3.93	1900	307	15	90	1990	1179
3.5	0.19	0.02	0.08	4.90	2730	382	24	170	2900	1180
4.1	0.26	0.03	0.09	5.88	3670	459	35	280	3950	1181
4.5	0.31	0.03	0.11	6.46	4260	504	42	350	4610	1181.6
5.4	0.45	0.05	0.13	7.82	5820	610	61	580	6400	1183
6.0	0.56	0.06	0.14	8.80	7050	686	77	790	7840	1184
6.7	0.70	0.07	0.16	9.77	8410	762	95	1050	9460	1185
7.2	0.80	0.08	0.16	10.76	9800	839	116	1350	11150	1186

(9) $v_a = Q_{TOT} / A_a$

(10) $h_a = v_a^2 / 2g$

(11) REF 1 PG 371

(12) $h_f = (135\,FT)\left[(0.?)(0.041) / (1.49) R_h^{2/3}\right]^2$ w/ DEFINITIONS GIVEN ON SHEET 8 ; w/

WETTED PERIMETER ≈ 10 FT + $\sqrt{[2 \times (3.0FT + H + 0FT)/2]^2 + [(3.0FT + H + 0FT)/2]^2}$

$+ \{[(3.0FT + H) \times 15FT] + [\frac{(3.0FT + H + 0FT)}{2} \times 18FT]\} / 33FT$; FLOW AREA ≈ A_a

FOR H ≤ 7FT, OTHERWISE ENTIRE QUANTITY ≈ 10FT; FOR H ≤ 3FT, OTHERWISE ENTIRE QUANTITY ≈ 3.0FT

(13) $H_e = H - 0.1h_a - h_f$; (14) FINAL $Q_w = C\,(T?FT)\,H_e^{3/2}$; A_w, A_{ww}, Q_{ww}, Q_{TOT} ARE DEFINED AS ...

SUBJECT DAM SAFETY INSPECTION
VIRGIN RUN DAM

BY WJV DATE 7-23-79 PROJ. NO. 79-617-196

CHKD. BY DLB DATE 7-24-79 SHEET NO. 12 OF 14

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EMBANKMENT RATING CURVE

- LENGTH OF EMBANKMENT SUBMERGED VS RESERVOIR ELEVATION (BASED ON FIELD MEASUREMENTS):

EMBANKMENT LENGTH (FT)	RESERVOIR ELEVATION (FT)	
0	1191.6	
30	1192.0	
110	1192.1	
200	1192.3	
350	1192.4	
400	1193.3	
405	1194.0	BASED ON APPROXIMATE 5H TO 1V RT ABUTMENT SS AS MEASURED ON THE USGS DAWSON, PA QUAD
410	1195.0	
415	1196.0	

- ASSUME THE EMBANKMENT ACTS LIKE A BROAD-CRESTED WEIR WHEN OVERTOPPED, W/ DISCHARGE DEFINED BY:

$$Q = C L H^{3/2}$$ (SHEET 6)

WHERE L = LENGTH OF EMBANKMENT INUNDATED IN FT;
C = DISCHARGE COEFFICIENT FOR EMBANKMENTS
= f (H/ℓ WHERE ℓ = BREADTH OF CREST ≈ 10 FT, AND REF 12, PG 46);
H = AVERAGE "FLOW-AREA WEIGHTED" HEAD ABOVE THE LOW TOP OF DAM EL 1191.6 FT. SINCE THE LOW POINT OCCURS NEAR THE RIGHT SPILLWAY WINGWALL, ASSUME THAT THE CREST IS LINEARLY INCLINED FROM THE LOW POINT TO THE RESERVOIR ELEVATION IN QUESTION OVER THE

SUBJECT DAM SAFETY INSPECTION
VIRGIN RUN DAM

BY WJV DATE 7-23-79 PROJ. NO. 78-617-196

CHKD. BY DLB DATE 7-24-79 SHEET NO. 13 OF 14

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ENTIRE INUNDATED EMBANKMENT CREST LENGTH
⇒ H ≈ (RESERVOIR ELEVATION - EL 1181.6 FT) / 2

RESERVOIR ELEVATION (FT)	① Y (FT)	② H (FT)	H/ℓ (FT/FT)	C	③ L (FT)	Q (CFS)
1181.6	—	—	—	—	0	0
1182.0	0.4	0.20	0.02	2.97	30	10
1182.1	0.5	0.25	0.03	2.98	110	40
1182.3	0.7	0.35	0.04	3.00	200	120
1182.4	0.8	0.40	0.04	3.01	350	270
1183.3	1.7	0.85	0.09	3.03	400	950
1184.0	2.4	1.2	0.12	3.04	405	1620
1185.0	3.4	1.7	0.17	3.06	410	2780
1186.0	4.4	2.2	0.22	3.08	415	4170

① Y = EL RESERVOIR - EL 1181.6 FT
② H ≈ Y/2
③ FROM SHEET 12

TOTAL FACILITY RATING CURVE

TOTAL DISCHARGE = $Q_{SPILLWAY} + Q_{EMBANKMENT}$

(SEE TABLE ON SHEET 14)

SUBJECT DAM SAFETY INSPECTION
VIRGIN RUN DAM

BY WJV DATE 7-23-79 PROJ. NO. 78-617-196

CHKD. BY DLB DATE 7-24-79 SHEET NO. 14 OF 14

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RESERVOIR ELEVATION (FT)	① $Q_{SPILLWAY}$ (CFS)	② $Q_{EMBANKMENT}$ (CFS)	Q_{TOTAL} (CFS)
1175.0	0	–	0
1176.0	220	–	220
1177.0	660	–	660
1178.0	1250	–	1250
1179.0	1990	–	1990
1180.0	2900	–	2900
1191.0	3950	–	3950
LOW TOP OF DAM – ELEVATION 1191.6	4610	0	4610
1192.0	5120*	10	5130
1192.1	5250*	40	5290
1192.3	5510*	120	5630
1192.4	5630*	270	5900
1193.0	6400	720*	7120
1193.3	6830*	950	7780
1194.0	7840	1620	9460
1195.0	9460	2780	12240
1196.0	11150	4170	15320

① FROM SHEET 11
② FROM SHEET 13
* INTERPOLATED VALUE

SUMMARY INPUT/OUTPUT SHEETS

DAM SAFETY INSPECTION
VIRGIN RUN DAM ****** OVERTOPPING ANALISIS ******
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	0	0
			JOPER	NWT	LKOPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALISES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1
RTIOS= .60 .70 .80 .90 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW INTO VIRGIN RUN RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	3.30	0.00	3.30	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	102.00	120.00	130.00	140.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

INITIAL AND CONSTANT RAINFALL LOSSES AS PER COE

LOSS DATA

LKOPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMA	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.26 CP= .40 NTA= 0

BASE FLOW PARAMETERS AS PER COE

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.79 AND R=14.16 INTERVALS

UNIT HYDROGRAPH 60 END-OF-PERIOD ORDINATES, LAG= 1.25 HOURS, CP= .40 VOL= 1.00

28.	106.	218.	350.	482.	590.	662.	685.	658.	613.
571.	532.	496.	462.	431.	401.	374.	348.	325.	303.
282.	263.	245.	228.	213.	198.	185.	172.	160.	149.
139.	130.	121.	113.	105.	98.	91.	85.	79.	74.
69.	64.	60.	56.	52.	48.	45.	42.	39.	36.
34.	32.	29.	27.	26.	24.	22.	21.	19.	18.
17.	16.	15.	14.	13.	12.	11.	10.	9.	9.
8.	8.	7.	7.	6.	6.	5.	5.	5.	4.

SUBJECT DAM SAFETY INSPECTION
VIRGIN RUN DAM
OVERTOPPING
BY WJV DATE 7-26-79 PROJ. NO. 73-617-196
CHKD. BY DLB DATE 7-26-79 SHEET NO. A OF C

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SUBJECT DAM SAFETY INSPECTION

VIRGIN RUN DAM

BY WJV DATE 7-26-79 PROJ. NO. 78-617-196

CHKD. BY DLB DATE 7-26-79 SHEET NO. B OF C

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JRJ CONSULTANTS, INC

END-OF-PERIOD FLOW

O MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.88	24.46	2.42	298347.
										(683.)(621.)(61.)(8448.25)			

INFLOWS INTO RESERVOIR

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7899.	5493.	2009.	1034.	297873.
CMS	224.	156.	57.	29.	8435.
INCHES		15.48	22.65	23.32	23.32
MM		393.29	575.41	592.43	592.43
AC-FT		2724.	3965.	4103.	4103.
THOUS CU M		3360.	4915.	5061.	5061.

0.6 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4739.	3296.	1205.	621.	178724.
CMS	134.	93.	34.	18.	5061.
INCHES		9.29	13.59	13.99	13.99
MM		235.97	345.24	355.46	355.46
AC-FT		1634.	2391.	2462.	2462.
THOUS CU M		2016.	2949.	3037.	3037.

0.7 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5529.	3845.	1406.	724.	208511.
CMS	157.	109.	40.	21.	5904.
INCHES		10.84	15.86	16.33	16.33
MM		275.30	402.78	414.70	414.70
AC-FT		1907.	2790.	2872.	2872.
THOUS CU M		2352.	3441.	3543.	3543.

HYDROGRAPH ROUTING

ROUTE INFLOW THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
101	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1175.	-1

STAGE	1175.00	1176.00	1177.00	1178.00	1179.00	1180.00	1181.00	1181.60	1182.00
	1182.30	1182.40	1183.00	1183.30	1184.00	1185.00	1186.00		
FLOW	0.00	220.00	660.00	1250.00	1990.00	2900.00	3950.00	4610.00	5130.00
	5630.00	5900.00	7120.00	7780.00	9460.00	12240.00	15320.00		
SURFACE AREA=	0.	32.	45.	49.	58.	70.			
CAPACITY=	0.	420.	612.	687.	869.	1188.			
ELEVATION=	1136.	1175.	1180.	1182.	1185.	1190.			

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1175.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1181.6	0.0	0.0	0.

SUBJECT DAM SAFETY INSPECTION

VIRGIN RUN DAM

BY WJV DATE 7-26-79 PROJ. NO. 79-617-19

CHKD. BY DLB DATE 7-26-79 SHEET NO. C OF C

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RESERVOIR OUTFLOW HYDROGRAPHS

OVERTOPPING OCCURS @ ≈ 0.62 PMF

PEAK OUTFLOW IS 7637. AT TIME 41.33 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7637.	5437.	1963.	1008.	290424.
CMS	216.	154.	56.	29.	8224.
INCHES		15.33	22.14	22.74	22.74
MM		389.26	562.28	577.62	577.62
AC-FT		2696.	3894.	4000.	4000.
THOUS CU M		3325.	4803.	4934.	4934.

PMF

PEAK OUTFLOW IS 4415. AT TIME 41.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4415.	3249.	1172.	602.	173380.
CMS	125.	92.	33.	17.	4910.
INCHES		9.16	13.21	13.58	13.58
MM		232.62	335.67	344.83	344.83
AC-FT		1611.	2324.	2388.	2388.
THOUS CU M		1987.	2867.	2946.	2946.

0.6 PMF

PEAK OUTFLOW IS 5198. AT TIME 41.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5198.	3797.	1370.	704.	202613.
CMS	147.	108.	39.	20.	5737.
INCHES		10.70	15.44	15.87	15.87
MM		271.83	392.23	402.97	402.97
AC-FT		1883.	2716.	2791.	2791.
THOUS CU M		2322.	3351.	3442.	3442.

0.7 PMF

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1175.00	1175.00	1181.60
STORAGE	420.	420.	687.
OUTFLOW	0.	0.	4610.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.60	1181.42	0.00	678.	4415.	0.00	41.67	0.00
.70	1182.04	.44	709.	5198.	2.00	41.50	0.00
.80	1182.48	.88	731.	6060.	2.67	41.33	0.00
.90	1182.87	1.27	751.	6850.	3.33	41.33	0.00
1.00	1183.24	1.64	771.	7637.	3.83	41.33	0.00

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2. "Unit Hydrograph Concepts and Calculations," by Corps of Engineers, Baltimore District (L-519).

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13. Applied Hydraulics in Engineering, Morris, Henry M. and Wiggert, James N., Virginia Polytechnic Institute and State University, 2nd Edition, The Ronald Press Company, New York, 1972.

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15. Engineering Field Manual, U. S. Department of Agriculture, Soil Conservation Service, 2nd Edition, Washington, D. C. 1969.

APPENDIX D

PHOTOGRAPHS

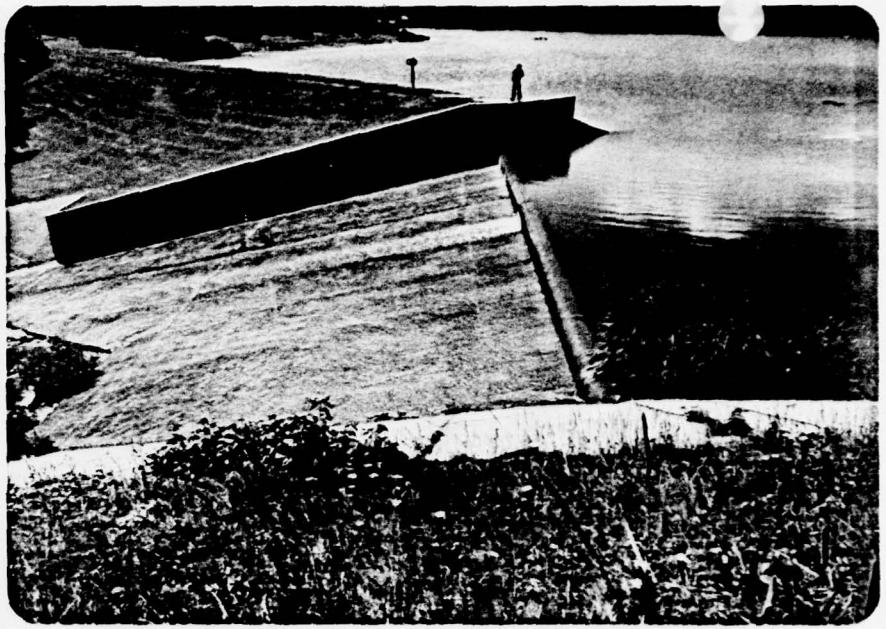
PHOTOGRAPH 1 View, looking south, at Virgin Run Lake and watershed.

PHOTOGRAPH 2 View of spillway located adjacent the left abutment.

PHOTOGRAPH 3 View of the spillway channel as seen from the edge of the plunge pool.

PHOTOGRAPH 4 View of the upstream embankment slope and control tower riser as seen from the right abutment.

1



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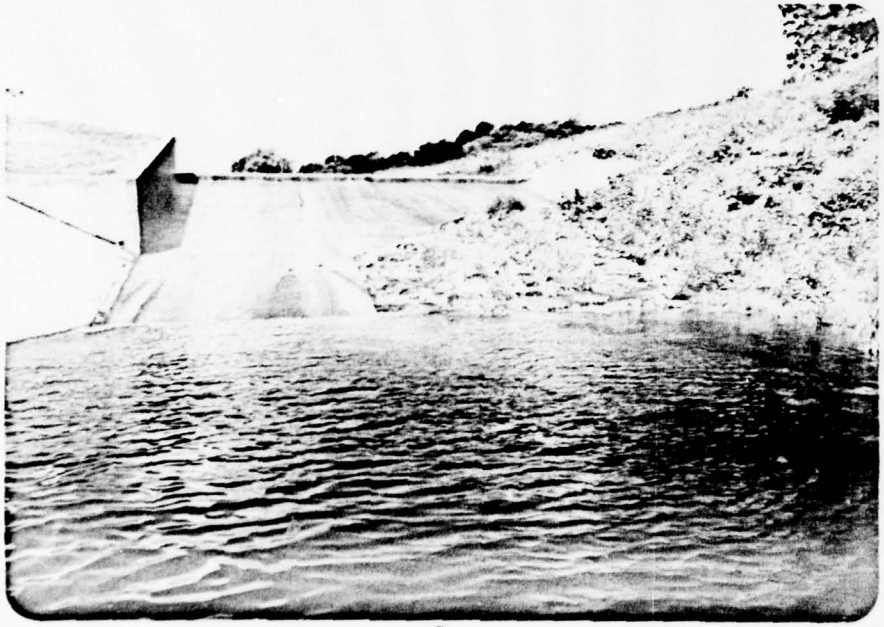

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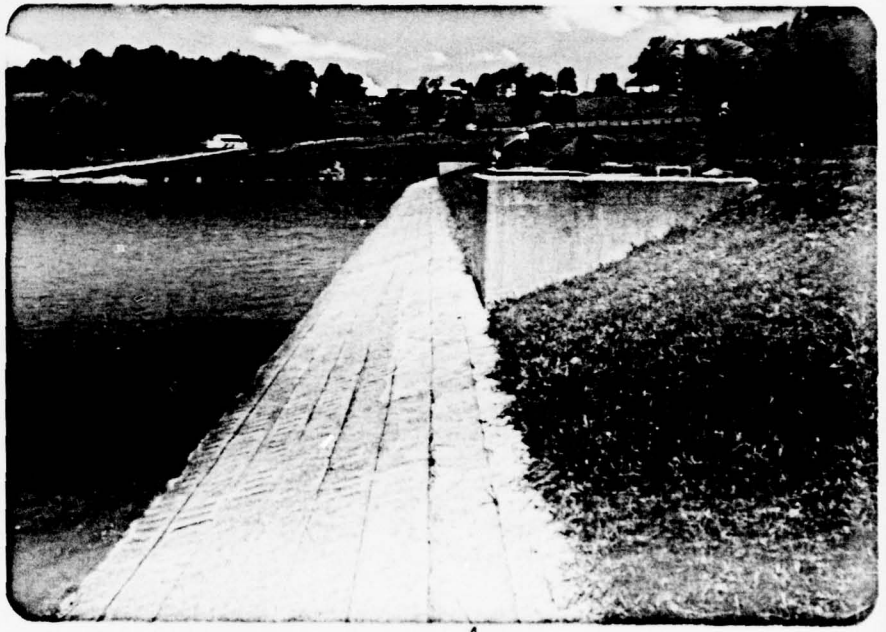

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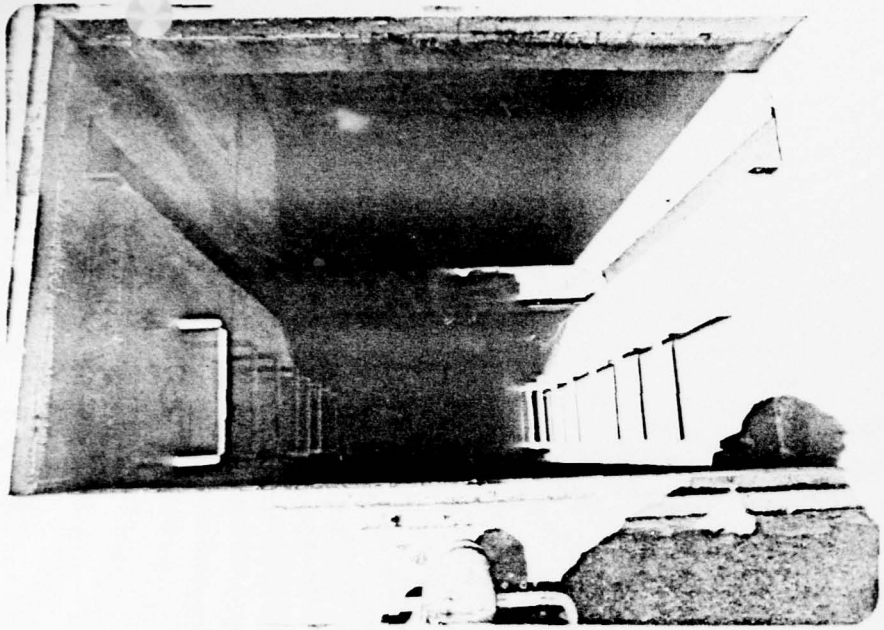
PHOTOGRAPH 5 Close-up view of the interior of the control tower riser.

PHOTOGRAPH 6 View of headwall at the discharge end of the outlet culvert. Note the heavy growth surrounding the culvert headwall.

PHOTOGRAPH 7 View of the overgrown downstream embankment toe as seen from the embankment crest.

PHOTOGRAPH 8 View, looking upstream, of the dwelling situated nearest the stream located about 1,500 feet downstream of the embankment.



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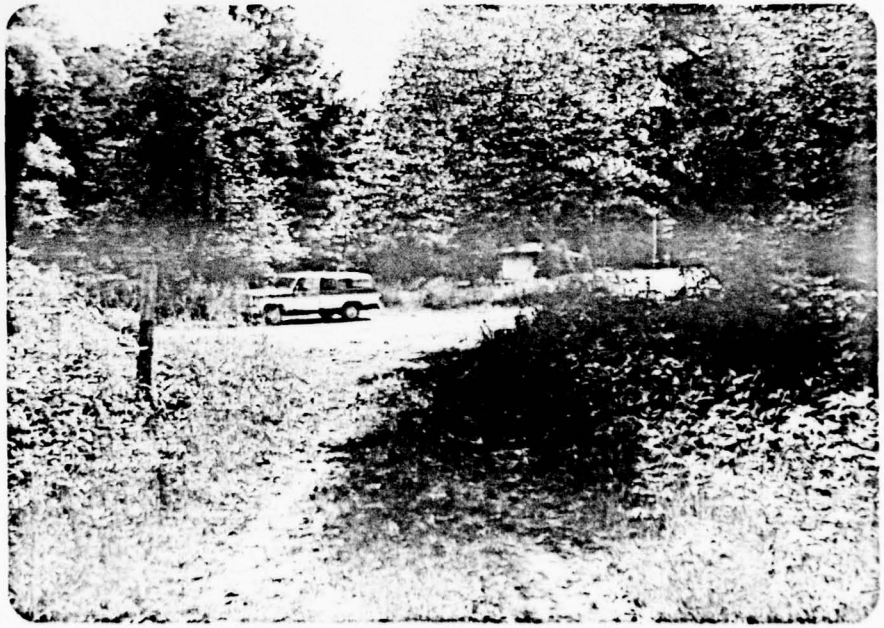

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APPENDIX E

GEOLOGY

Geology

Virgin Run Dam is located in the Pittsburgh Plateaus Section of the Appalachian Plateaus Physiographic Province. The Pittsburgh Plateaus Section is characterized by flat lying to very gently folded sedimentary rock strata of Pennsylvanian age. Major structural axes strike from southwest to northeast with the rock strata generally dipping northwest and southeast. The amplitude of folding in this section is quite low, consequently, surface expression of the anticlinal axes is not evident.

Virgin Run Dam and reservoir are located approximately seven miles west of Connellsville on Virgin Run, a first order tributary to the Youghiogheny River. Structurally, the dam lies immediately east of and parallel to the axial trace of the Fayette anticline. Rock strata underlying the dam and reservoir, therefore, dip to the east at approximately 400 feet per mile or about 3 degrees off the east flank of the anticline, and also dip to the south at slightly more than 1 degree in the direction of plunge along the axial trace.[1]

The dam and reservoir are located on sedimentary rock strata of the Conemaugh Group of Pennsylvanian age. The embankment is constructed on bedrock of the Conemaugh Group.

Data from one boring drilled in the valley floor indicates that the embankment is founded on the thin bedded, fine

grained sandstones and sandy shales of the lowermost portion of the Conemaugh Group (Mahoning sandstone). The top of the Allegheny Group containing the Upper Freeport Coal lies approximately 44 feet beneath the embankment. Drilling data indicates the Upper Freeport seam to be about 10 inches thick at this location.[2] Available information shows the Upper Freeport Coal has not been mined in the immediate vicinity of the dam and reservoir. This seam, however, has been strip mined about one mile north of the site along the Youghiogheny River.

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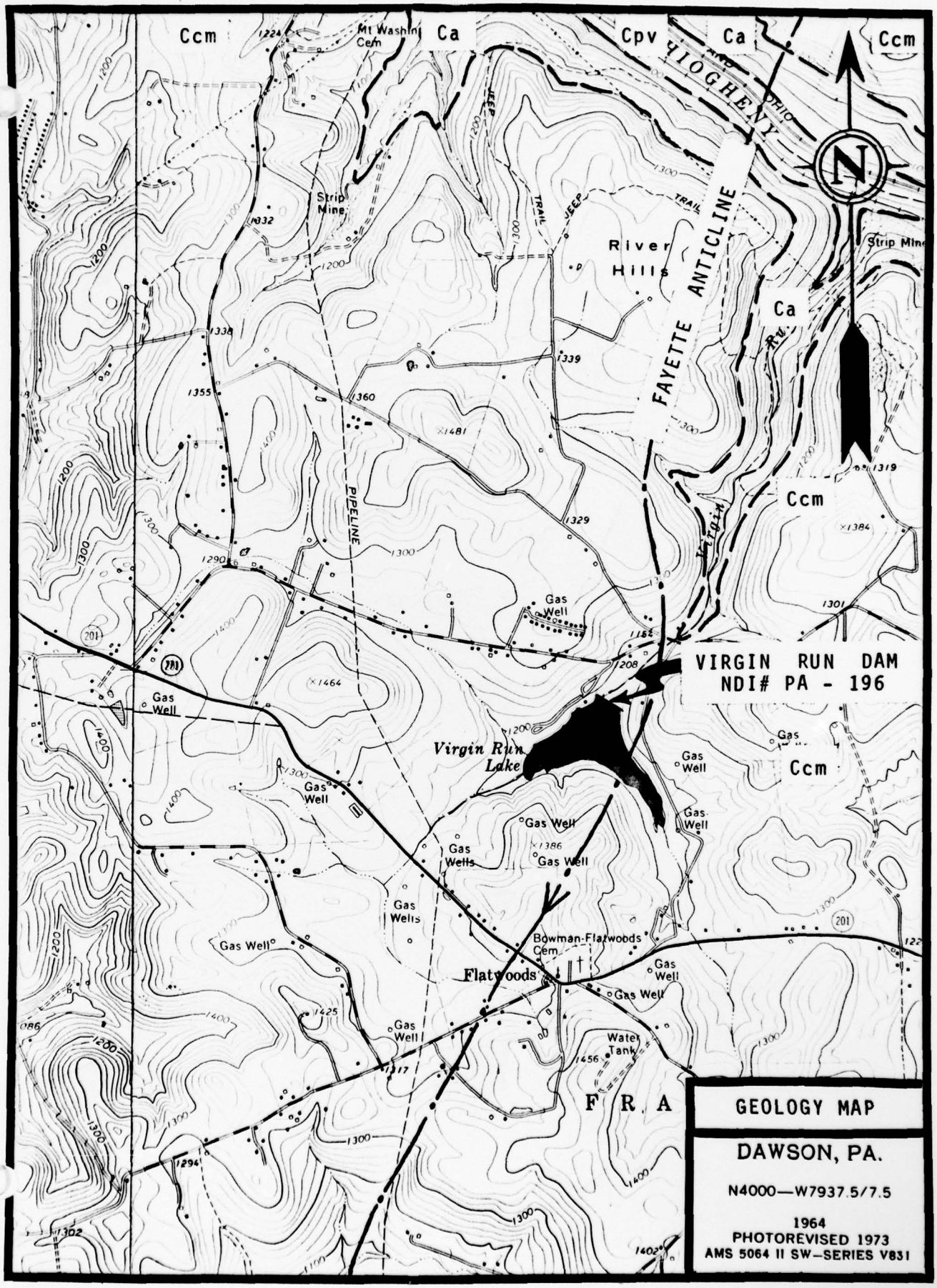
[1]Brownville-Connellsville Folio, Pennsylvania, U. S. Geological Survey, No. 94, 1903.

[2]Boring Log, PennDER files.


Ccm
Mt Washington Cem
Ca
Cpv
Ca
Ccm
MONONGAHELA
OHIO
RIVER
N
Strip Mine
JEEP TRAIL
River Hills
FAYETTE ANTICLINE
Ca
Rv
Strip Mine
1319
Ccm
1384
1301
VIRGIN RUN DAM
NDI# PA - 196
PIPELINE
Gas Well
Virgin Run Lake
Gas Wells
Gas Well
Ccm
Gas Well
Gas Well
Gas Wells
Gas Well
Gas Wells
Gas Well
Bowman-Flatwoods Cem
Flatwoods
Gas Well
Gas Well
Gas Well
Water Tank
1456
F R A
GEOLOGY MAP
DAWSON, PA.
N4000—W7937.5/7.5
1964
PHOTOREVISED 1973
AMS 5064 II SW—SERIES V831

APPENDIX F

FIGURES

LIST OF FIGURES

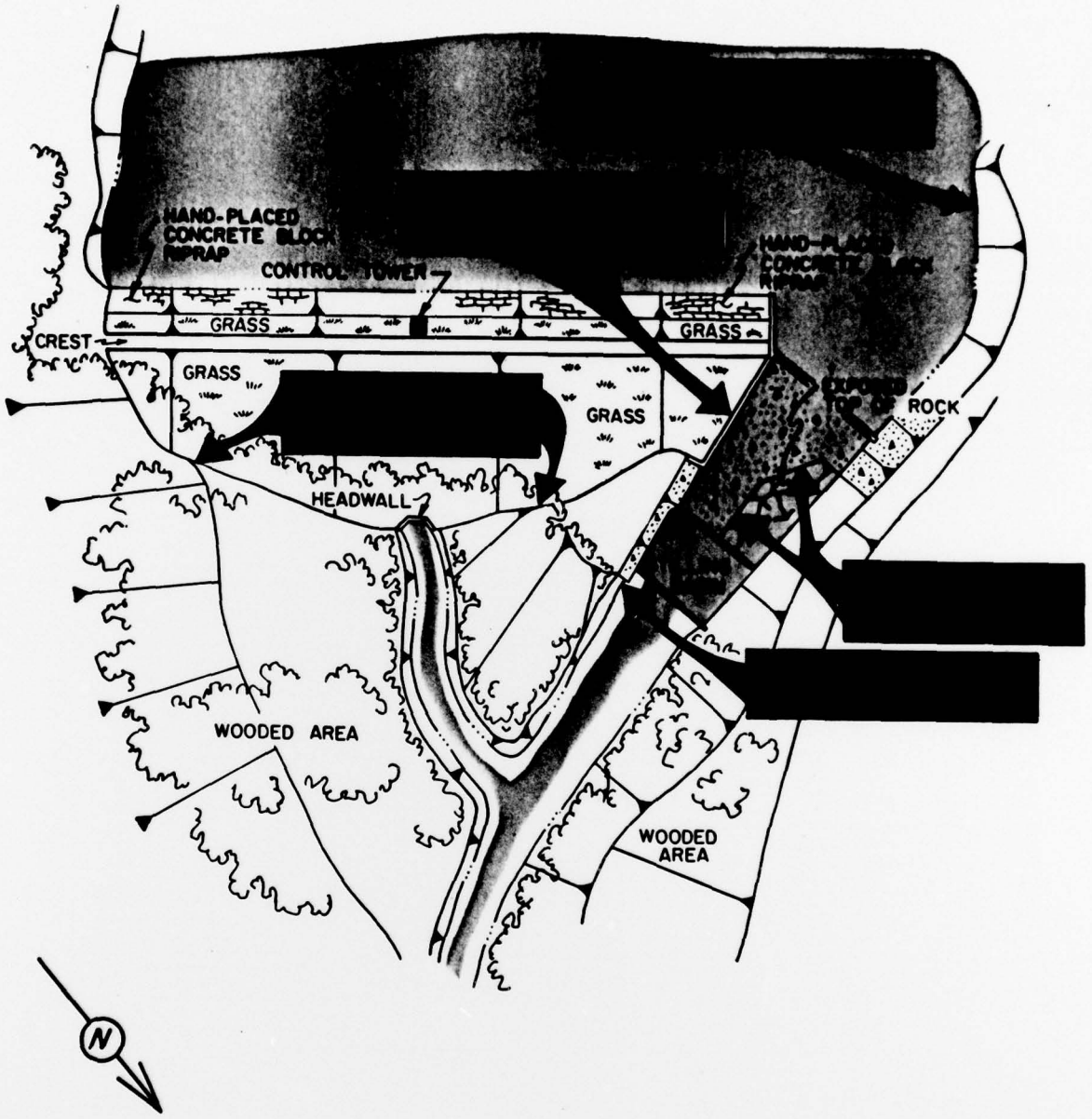
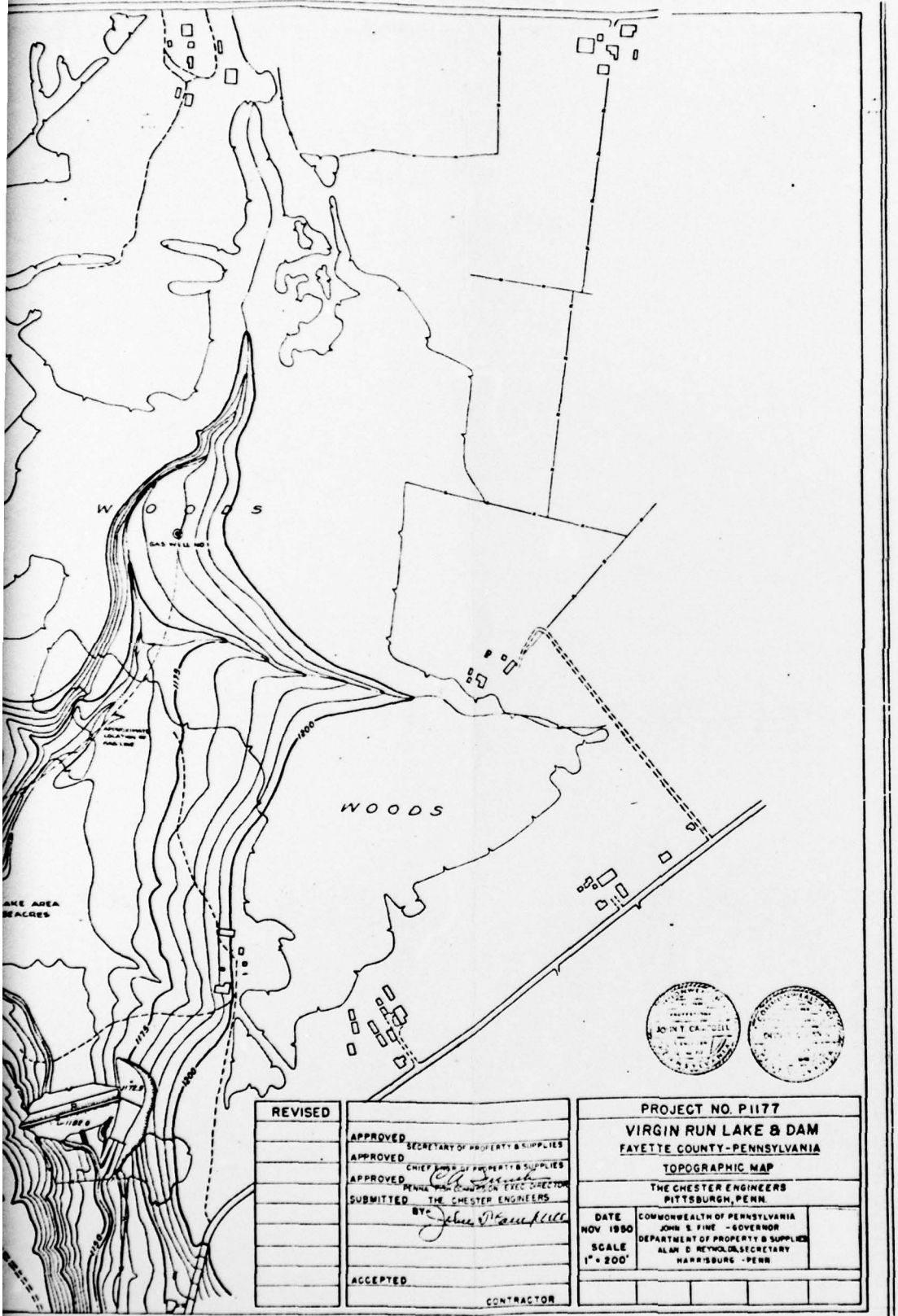


FIGURE 1 - VIRGIN RUN DAM

GENERAL PLAN

FIELD INSPECTION NOTES


WOODS
WOODS



REVISED	
	APPROVED SECRETARY OF PROPERTY & SUPPLIES
	APPROVED CHIEF DIVISION OF PURCHASES
	APPROVED PENNA. FISH COMMISSION EXEC. DIRECTOR
	SUBMITTED THE CHESTER ENGINEERS BY: John D. Hamilton
	ACCEPTED CONTRACTOR

PROJECT NO. P1177

VIRGIN RUN LAKE & DAM

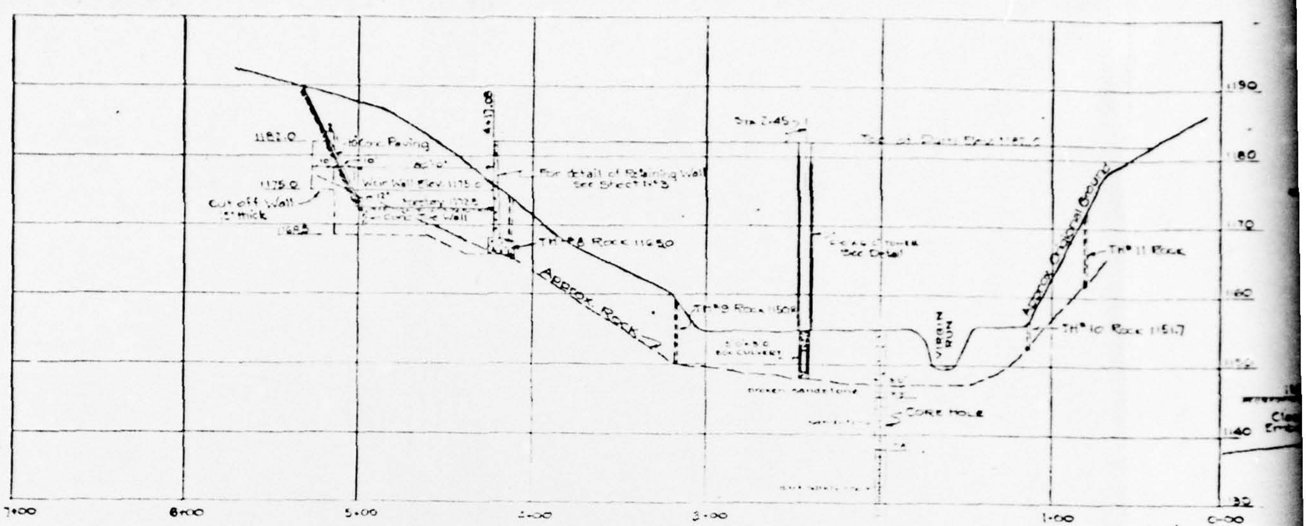
FAYETTE COUNTY-PENNSYLVANIA

TOPOGRAPHIC MAP

THE CHESTER ENGINEERS
PITTSBURGH, PENN.

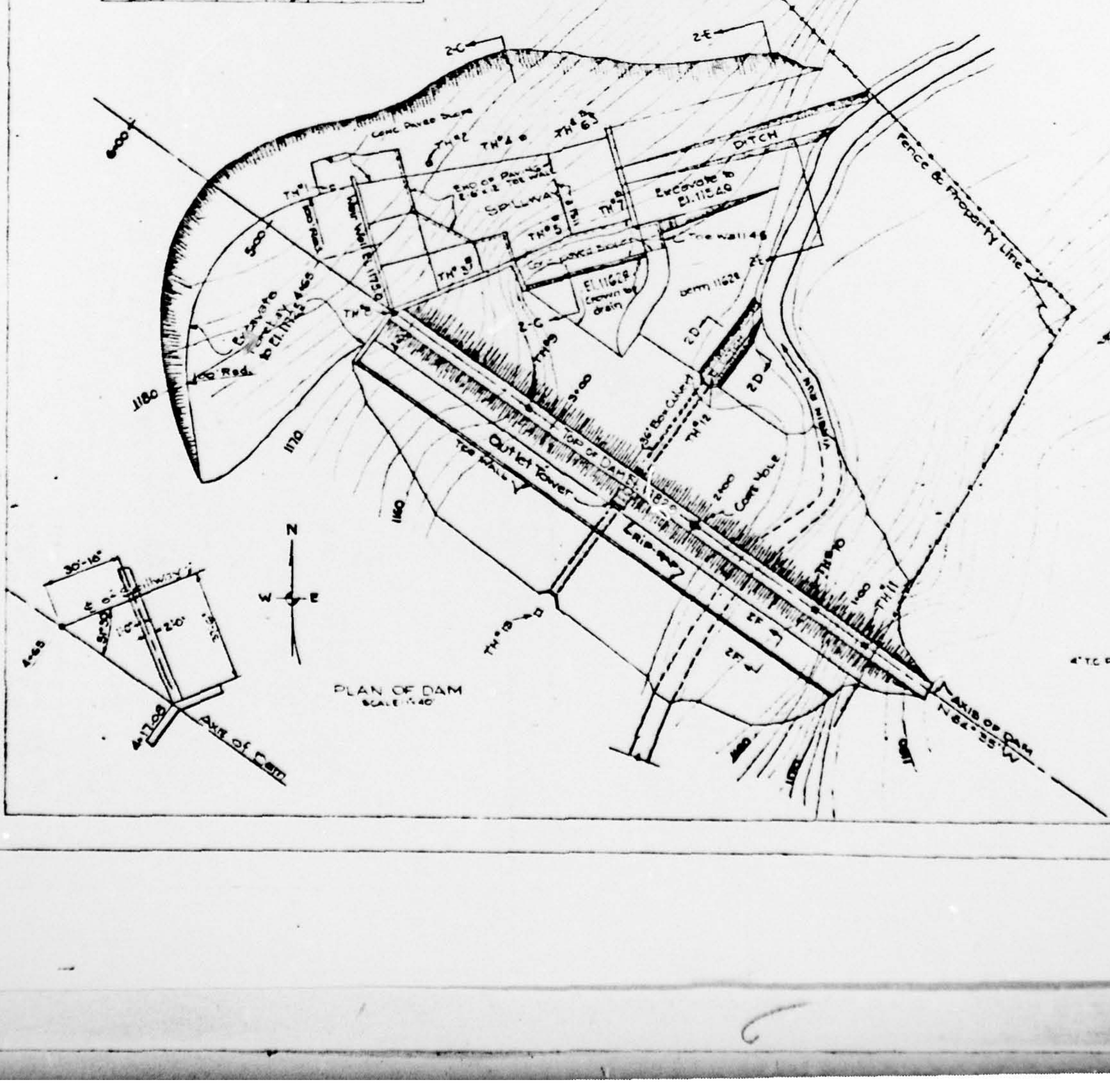
DATE	COMMONWEALTH OF PENNSYLVANIA
NOV 1950	JOHN S. FINE - GOVERNOR
SCALE	DEPARTMENT OF PROPERTY & SUPPLIES
1" = 200'	ALAN D. REYNOLDS, SECRETARY
	HARRISBURG - PENN.

FIGURE 2

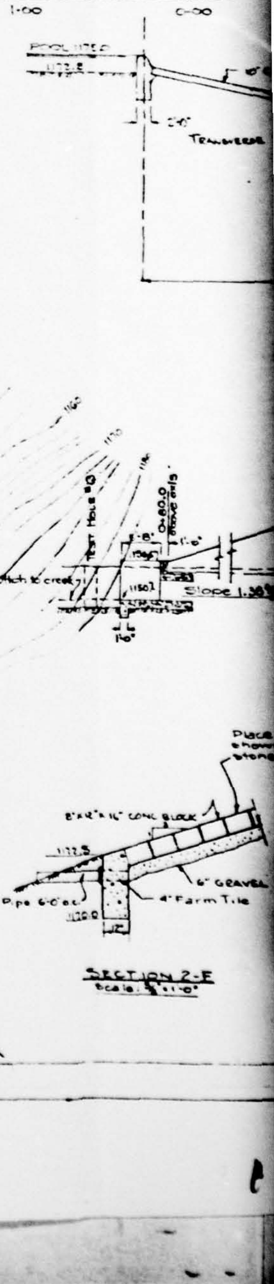


PROFILE OF DAM

Hole	Ground	Elev. of Rock	Material
1	1188.4	1175.8	Clay
2	1183.6	1173.4	Do
3	1171.0	1161.9	Do
4	1176.3	1169.7	Do
5	1163.7	1155.8	Do
6	1165.5	1163.5	Do
7	1162.4	[illegible]	Do
8	1172.8	1165.0	Do
9	1155.2	1149.9	Do
10	1155.6	1152.7	Do
11	1174.9	1161.7	Do
12	1154.7	1147.3	Do
13	1155.6	1149.7	Do



PLAN OF DAM
SCALE 1"=40'



SECTION 2-F

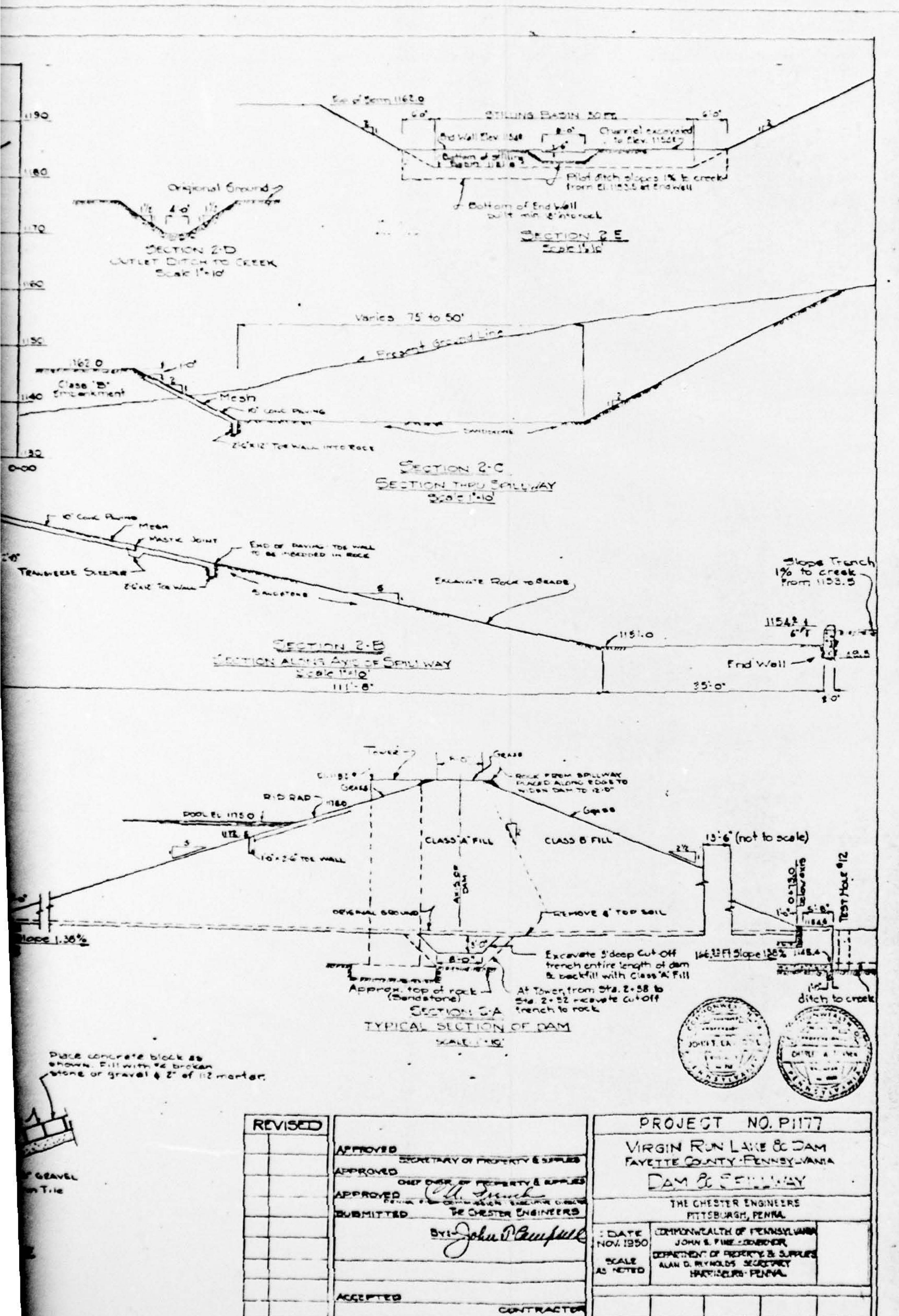
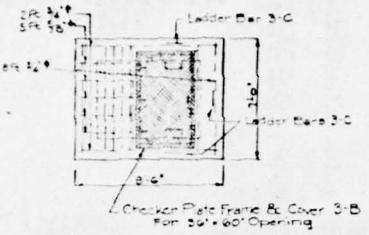
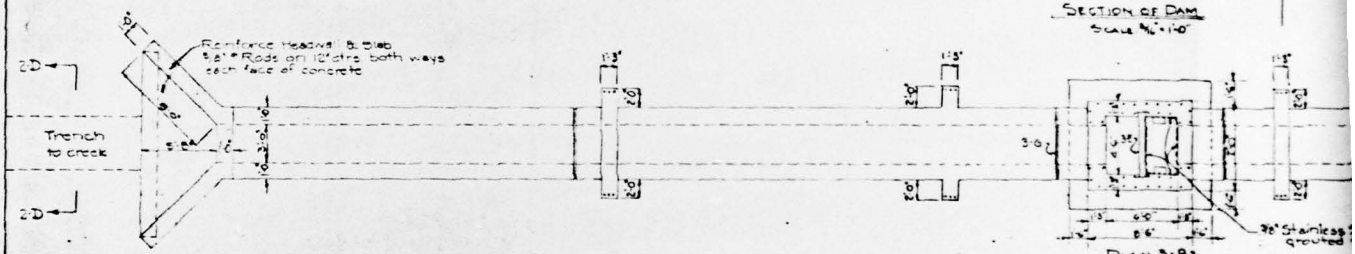


FIGURE 3 2351-2



TOP OF TOWER 3:A
Scale ½"=1'-0"

SECTION 3:B1
SECTION OF DAM
Scale ¾"=1'-0"



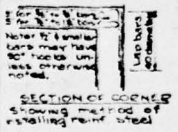
PLAN 3:B2
OUTLET TOWER & CULVERT
Scale ¾"=1'-0"

CONCRETE & REINFORCING STEEL SPECIFICATIONS

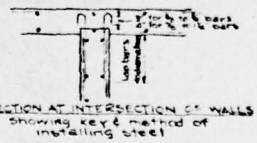
Keyways shall be provided at all construction joints and unless otherwise noted shall be a minimum of 2½" deep and ⅓ section in width.
Dowel bars shall be the same size as corresponding wall bars unless noted.
Square bars and spacing noted thus: ½"□@6" or ½"□ on 6"
Round bars and spacing noted thus: ½"ø @6" or ½"ø on 6"
Stress steel is always shown next to the surface of the wall and shall have the following cover from center of stress bar to surface:-

1½"	when member is	less than 12"	thick
2"	" "	12" to 18"	"
3"	" "	18" - 24"	"
	" "	over 24"	"

All corners and intersections of walls and intersections of slabs with wall shall have arrangement of steel shown below:-

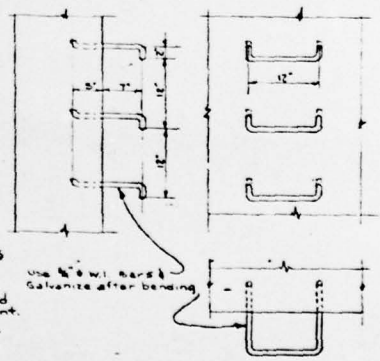


SECTION OF CORNER
Showing method of installing reinf steel

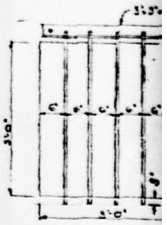


SECTION AT INTERSECTION OF WALLS
Showing key & method of installing steel

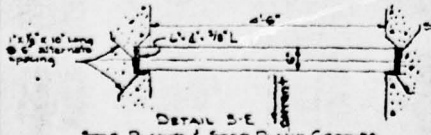
Only deformed bars shall be used.
The amount of steel shown shall be doubled thru construction joints and for a distance not less than 40 x diameter of bar each side of the joint.
All bars where jointed shall be lapped 40 x diameter of bar.
Dowels transmitting shear only shall be lapped 24 x diameter of bar.
All bars shall be bent around openings or sufficient additional bars provided to transmit stress.
Bevel exposed edges of concrete 1" bevel.
Where equipment or accessories embedded in concrete produce thin or confined sections as at wall corners adjacent to stop plank grooves etc. reinforce thin section with ½"ø bars @6" or wire mesh equivalent



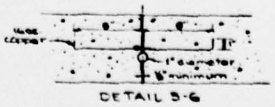
DETAIL 3:C LADDER BARS
Scale 1"=1'-0"



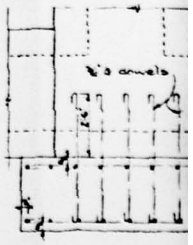
BAR SCREEN
Scale ¾"=1'-0"



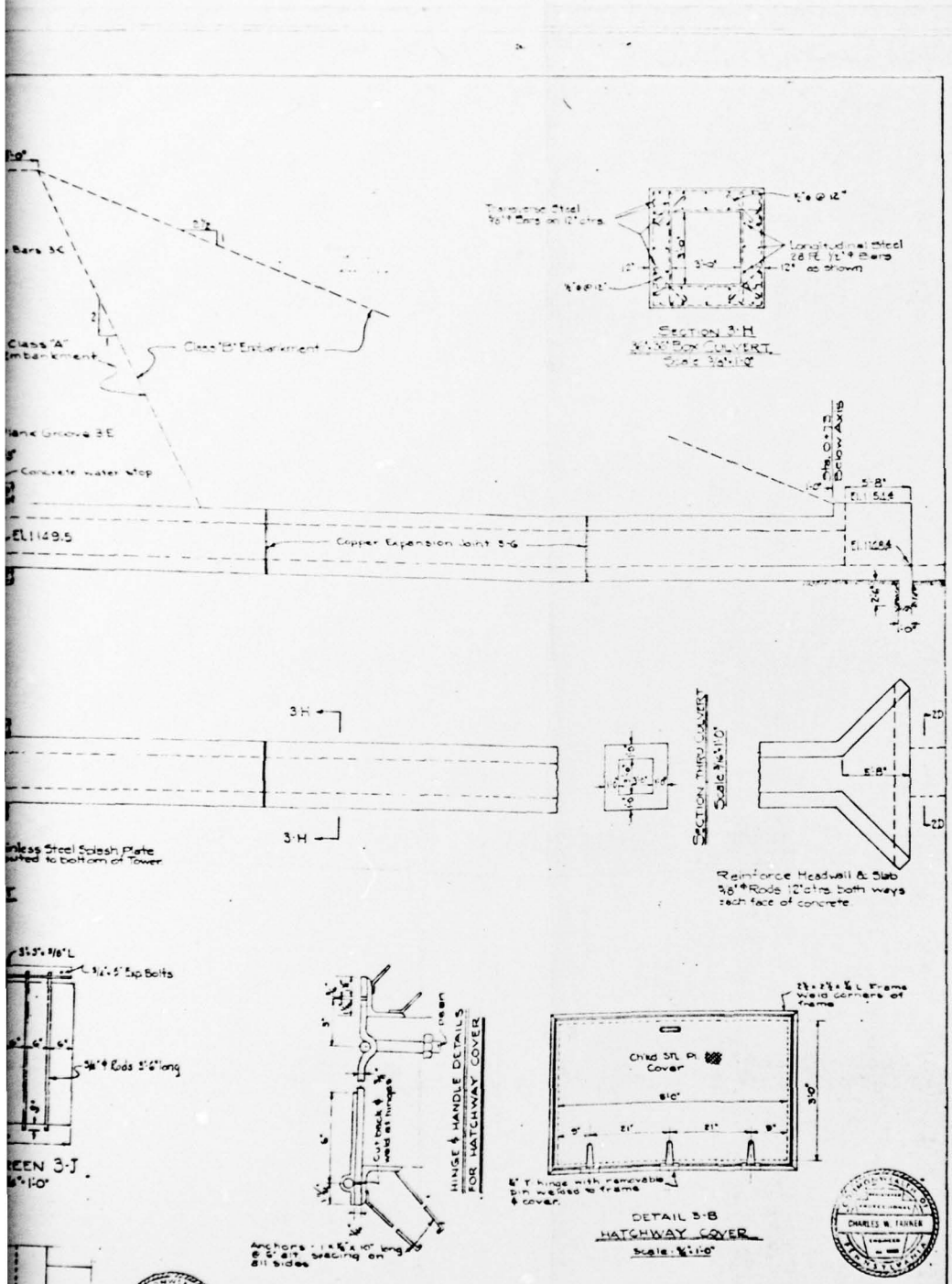
DETAIL 3:E
STOP PLANKS & STOP PLANK GROOVES
Scale ¾"=1'-0"



DETAIL 3:G
COPPER EXPANSION JOINT
Scale 1"=1'-0"



DETAIL 3:F
REINFORCING DETAILS
Scale ¾"=1'-0"



REVISED	
	APPROVED Secretary of Property & Supplies
	APPROVED Chief Engr. of Property & Supplies
	APPROVED Penna Fish Commission, Executive Director
	SUBMITTED The Chester Engineers
	By John D. Caulfield
	ACCEPTED Contractor

PROJECT NO. P1177

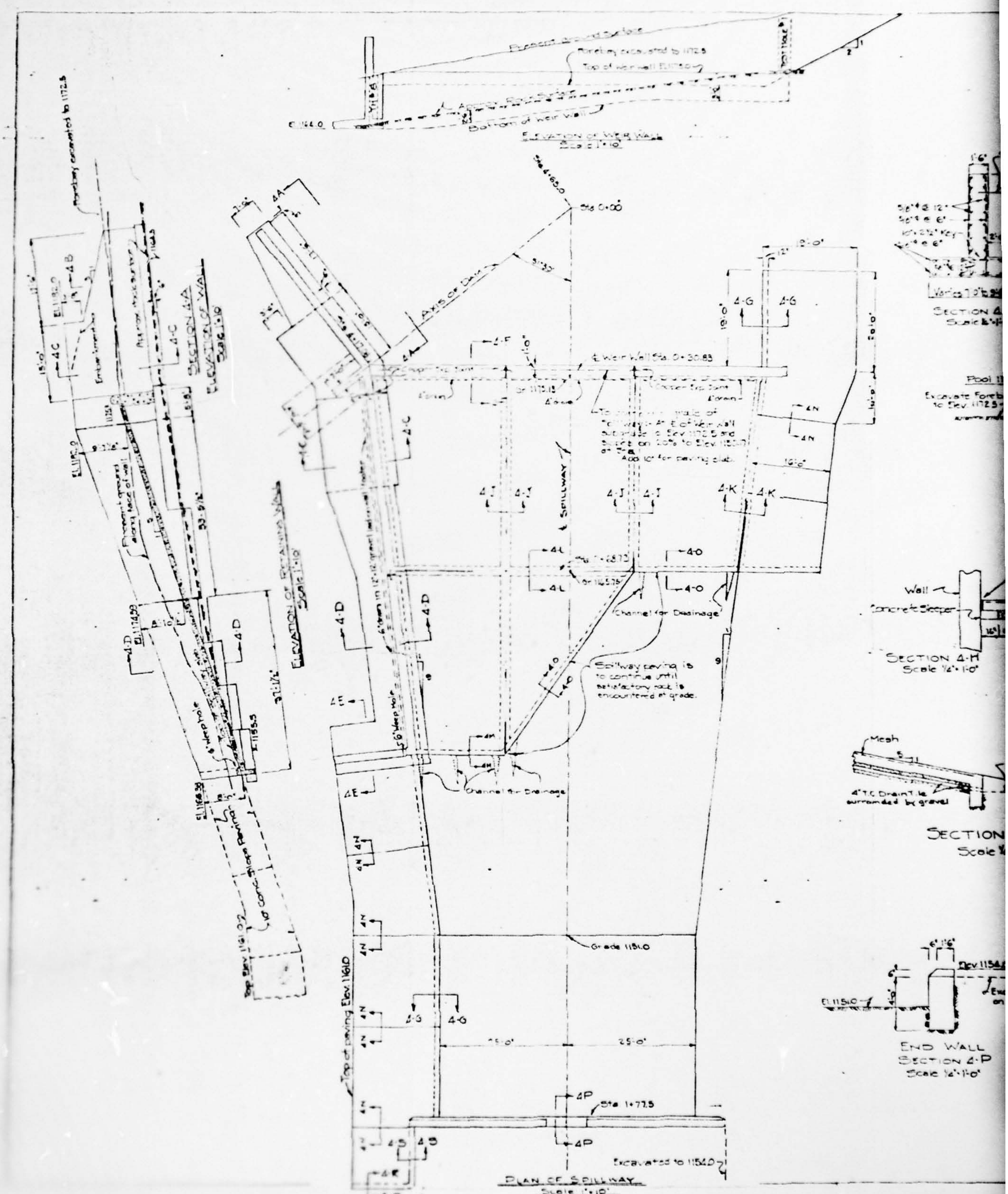
VIRGIN RUN LAKE & DAM
FAYETTE COUNTY, PENNSYLVANIA

OUTLET TOWER & CULVERT

THE CHESTER ENGINEERS
PITTSBURGH, PA.

DATE	COMMONWEALTH OF PENNSYLVANIA
NOV. 1950	JOHN S. FINE - GOVERNOR
SCALE AS NOTED	DEPARTMENT OF PROPERTY & SUPPLIES
	ALAN D. REYNOLDS SECRETARY
	HARRISBURG PENNA.

FIGURE 4 2351-3


Elevation of Weir Wall
Scale 1"=10'
Axis of Dam
Sta 0+00
℄ Weir Wall Sta 0+30.83
℄ Spillway
Channel for Drainage
Spillway paving is to continue until satisfactory rock is encountered at grade.
Grade 1150.0
Top of paving Elev 1161.0
Sta 1+77.5
Excavated to 1154.0
Plan of Spillway
Scale 1"=10'
Elevation of Retaining Wall
Scale 1"=10'
Section 4-A
Elevation of Wall
Scale 1"=10'
Wall
Concrete Sleeper
Section 4-H
Scale 1/2"=1'-0"
Mesh
4" T.C. Drain Tile surrounded by gravel
Section
End Wall
Section 4-P
Scale 1/2"=1'-0"

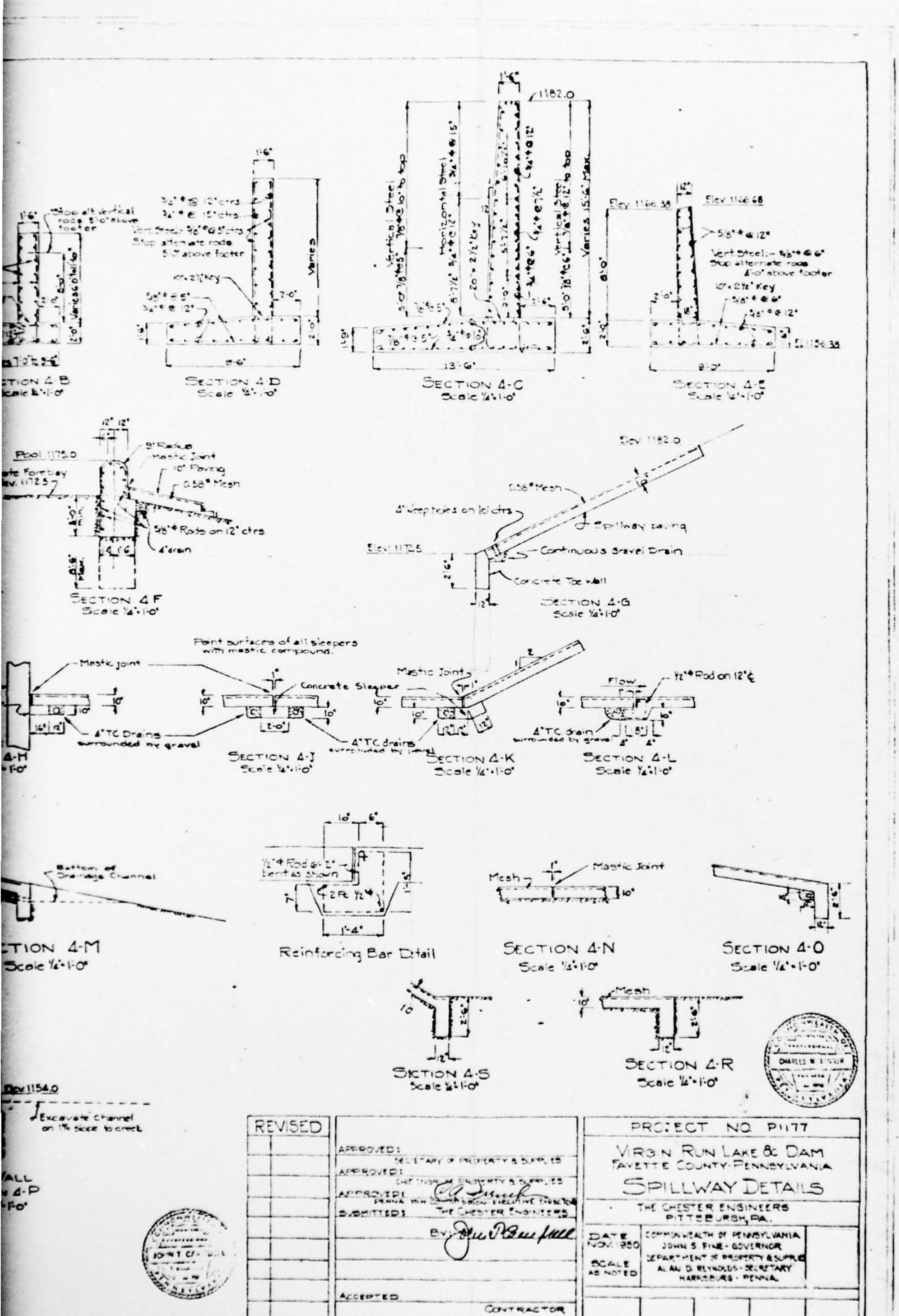

SECTION 4-B
SECTION 4-D
Scale 1/4"=1'-0"
SECTION 4-C
Scale 1/4"=1'-0"
SECTION 4-E
Scale 1/4"=1'-0"
SECTION 4-F
Scale 1/4"=1'-0"
SECTION 4-G
Scale 1/4"=1'-0"
Spillway paving
Continuous Gravel Drain
Concrete Toe Wall
Paint surfaces of all sleepers with mastic compound.
Concrete Sleeper
Mastic Joint
4" T.C. Drains surrounded by gravel
SECTION 4-H
SECTION 4-J
Scale 1/4"=1'-0"
SECTION 4-K
Scale 1/4"=1'-0"
SECTION 4-L
Scale 1/4"=1'-0"
Flow
Bottom of Drainage Channel
SECTION 4-M
Scale 1/4"=1'-0"
Reinforcing Bar Detail
SECTION 4-N
Scale 1/4"=1'-0"
SECTION 4-O
Scale 1/4"=1'-0"
SECTION 4-S
Scale 1/4"=1'-0"
SECTION 4-R
Scale 1/4"=1'-0"
Excavate channel on 1% slope to creek
REVISED
APPROVED: SECRETARY OF PROPERTY & SUPPLIES
APPROVED: CHIEF DIVISION OF PROPERTY & SUPPLIES
APPROVED: PENNA. STATE EXECUTIVE DIRECTOR
SUBMITTED: THE CHESTER ENGINEERS
ACCEPTED
CONTRACTOR
PROJECT NO. P1177
VIRGIN RUN LAKE & DAM
FAYETTE COUNTY - PENNSYLVANIA
SPILLWAY DETAILS
THE CHESTER ENGINEERS
PITTSBURGH, PA.
DATE NOV. 1950
SCALE AS NOTED
COMMONWEALTH OF PENNSYLVANIA
JOHN S. FINE - GOVERNOR
DEPARTMENT OF PROPERTY & SUPPLIES
ALAN D. REYNOLDS - SECRETARY
HARRISBURG - PENNA.

FIGURE 5

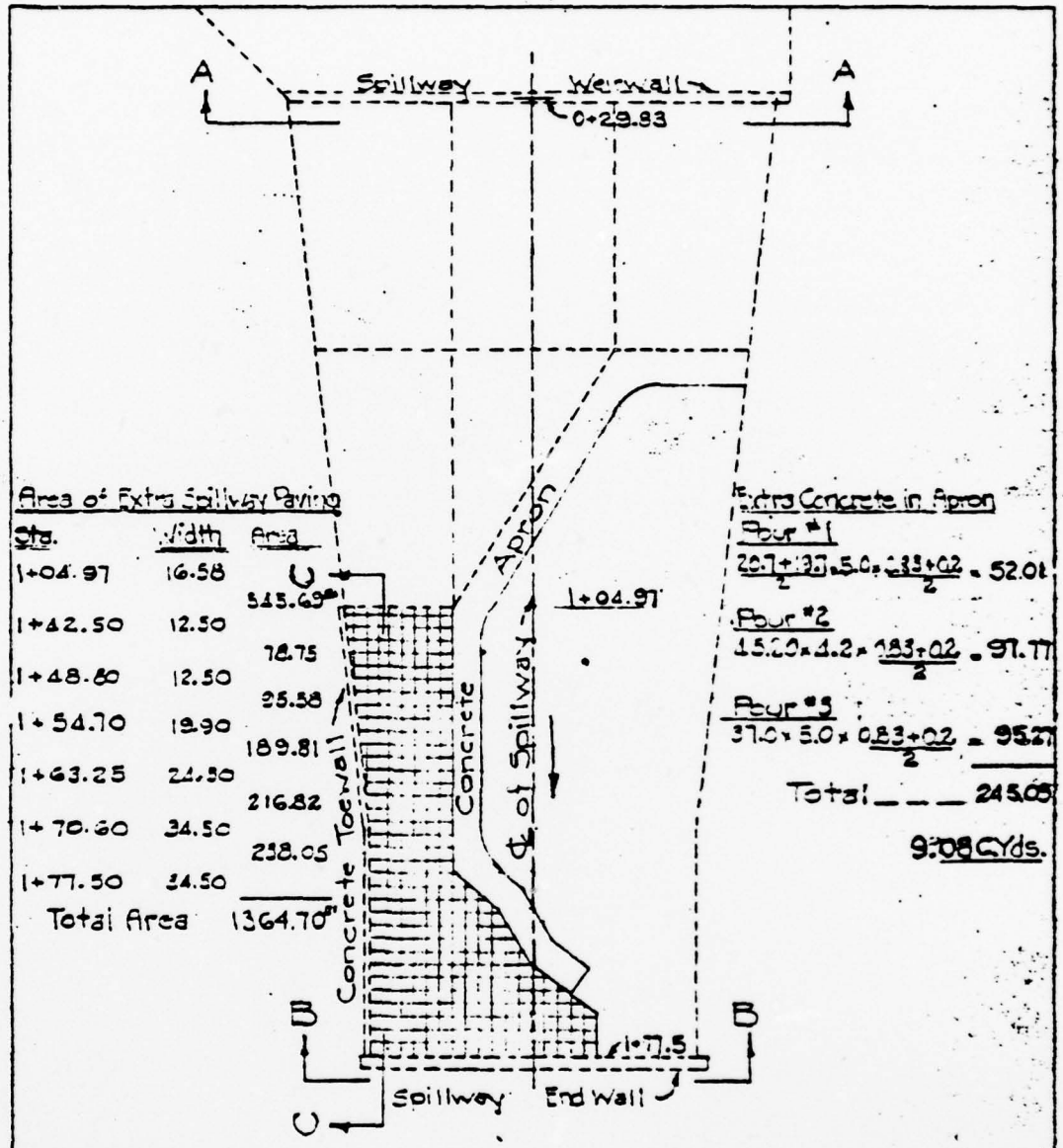
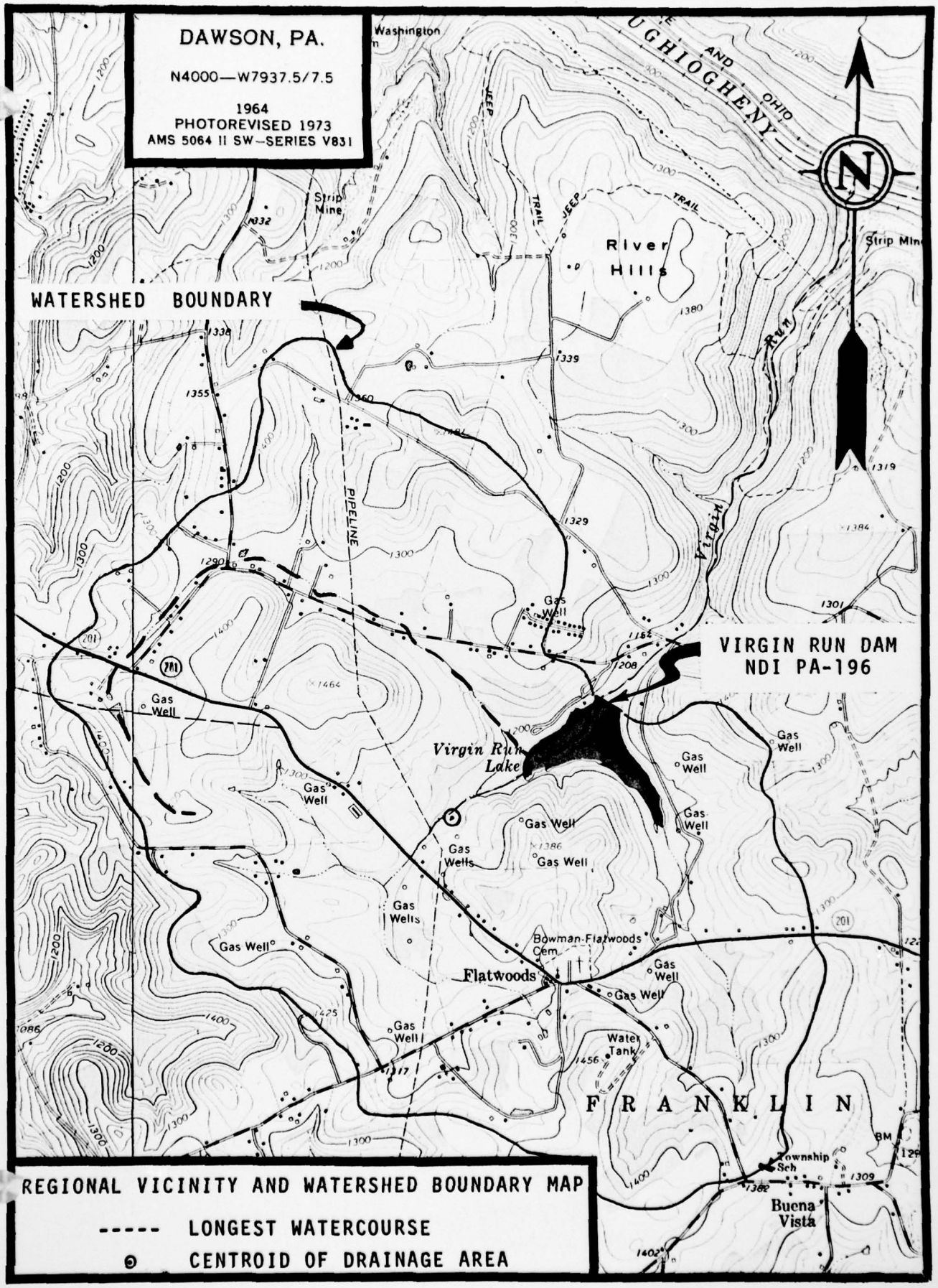

A
Spillway
Weirwall
0+29.93
A
Area of Extra Spillway Paving
Sta. Width Area
1+04.97 16.58
545.69
1+42.50 12.50
78.75
1+48.80 12.50
25.58
1+54.70 19.90
189.81
1+63.25 24.50
216.82
1+70.60 34.50
238.05
1+77.50 34.50
Total Area 1364.70
Concrete Toewall
Apron
℄ of Spillway
Concrete
1+04.97
Extra Concrete in Apron
Pour #1
20.7+33.5 / 2 × 5.0 × 33+02 / 2 = 52.01
Pour #2
15.20 × 4.2 × 183+02 / 2 = 97.77
Pour #3
37.0 × 5.0 × 83+02 / 2 = 95.27
Total 245.05
9.08 CYds.
B
B
1+77.5
C
C
Spillway
End Wall
Extra Work in Spillway
Excavation 1-Area 1364.70 S.F. x 0.83 x 1/27 = 41.95 Yd.
Class 'A' Concrete 1-Area 1364.70 S.F. x 0.83 x 1/27 = 41.95 CYd.
Extra Concrete in Apron 9.08 51.03 Yd
Mesh 1-Area 1357.36 S.F. 1364.70 S.F.
See Sheet 3 for:-
Section A-A Spillway Weir Wall
Section B-B Spillway End Wall
Section C-C Concrete Toe Wall
SHEET #2-A
P&S #1177 - CWT - 2/6/52

FIGURE 6

APPENDIX G

REGIONAL VICINITY AND WATERSHED BOUNDARY MAP


DAWSON, PA.
N4000—W7937.5/7.5
1964
PHOTOREVISED 1973
AMS 5064 II SW—SERIES V831
WATERSHED BOUNDARY
VIRGIN RUN DAM
NDI PA-196
Virgin Run Lake
Flatwoods
Bowman-Flatwoods Cem.
River Hills
Strip Mine
PIPELINE
JEEP TRAIL
Gas Well
Gas Wells
Water Tank
Township Sch
Buena Vista
FRANKLIN
Washington
AND OHIO
N
REGIONAL VICINITY AND WATERSHED BOUNDARY MAP
----- LONGEST WATERCOURSE
⊙ CENTROID OF DRAINAGE AREA